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# USSR Report

EARTH SCIENCES

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10 SEPTEMBER 1986

USSR REPORT  
EARTH SCIENCES

## CONTENTS

## METEOROLOGY

Device for Violent Weather Study Based on Thermodynamic Change (O. Nosareva; LENINGRADSKAYA PRAVDA, 29 Apr 86).....	1
International Conference on Air Pollution Modeling (LENINGRADSKAYA PRAVDA, 20 May 86).....	2
Institute's Work on Rainfall Modification in Chernobyl Area (T. Larina; PRAVDA UKRAINY, 24 May 86).....	3
Meteorological Effects of Geotectonic Phenomena Hypothesized (G. Afanasyev; SOVETSKAYA LITVA, 27 Apr 86).....	4
Third International Symposium on Tropical Meteorology (Yalta, 24-31 March 1985) (V.N. Ivanov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	6
Sharp Enhancement of Precipitation Intensity Accompanying Gravitational Coagulation (V.M. Voloshchuk; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	7
Status of Research on Anthropogenic Climate Changes (M.I. Budyko; GIDROMETEOROLOGIYA. SERIYA 37.21, METEOROLOGIYA, No 2, 1986).....	7

Synchronous Changes in Activity of Dangerous Phenomena and Their Prediction (B.L. Berri, S.M. Myagkov, et al.; VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA, No 3, May-Jun 86).....	8
--	---

## OCEANOGRAPHY

Nonmagnetic Vessel 'Zarya' Begins Black Sea Cruise (S. Nikonov; LENINGRADSKAYA PRAVDA, 17 Jul 86).....	9
Optical Tomograph Gives Instantaneous Interference Holograms (SOTSIALISTICHESKAYA INDUSTRIYA, 10 Jul 86).....	10
Research Ship 'Strakhov' Begins Atlantic Cruise (VODNYY TRANSPORT, 27 May 86).....	11
Polish-Built Research Ship 'Fersman' in Service (VODNYY TRANSPORT, 27 May 86).....	12
Shipboard Nuclear Analytical Complex for Mineral Prospecting (V. Bratchikova; TRUD, 13 May 86).....	13
IL-18 Meteorological Laboratory Airplane (VOZDUSHNYY TRANSPORT, 29 May 86).....	14
Work With Small Submersible Craft 'Okeanolog' in Far East (SOTSIALISTICHESKAYA INDUSTRIYA, 29 May 86).....	15
Institutes Involved in Aerospace Photography of Seas (V. Shirokov; PRAVDA, 14 Jul 86).....	16
Work on Resonance Robots With Low Power Consumption (I. Ivanov; VECHERNYAYA MOSKVA, 26 May 86).....	18
Example of Eddy Formation in Stratified Fluid (V.N. Anuchin, V.A. Gritsenko; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	19
Analysis of Lagrangian Statistical Characteristics of Synoptic Currents in Polymode Test Range (N.A. Maksimenko; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	20
Kinetic Model of Wind Wave Generation by Turbulent Wind (Yu.I. Nikolayeva, L.Sh. Tsimring; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	20
Hydrothermal-Sedimentary and Hydrothermal Ore Formations of World (G.A. Cherkashev, S.G. Krasnov, et al.; MORSKAYA GEOLOGIYA I GEOFIZIKA: GIDROTERMALNO-OSADOCHNYYE I GIDROTERMALNNYYE RUDNYYE OBRAZOVANIYA V MIROVOM OKEANE, 1985).....	21

Spatial Variability of Baroclinic Transport of Waters by Antarctic Circumpolar Current (A.F. Treshnikov, V.N. Botnikov; IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBRASHCHESTVA, No 2, Mar-Apr 86).....	22
Soviet Oceanographic Research Near Seychelles Islands (L.A. Ponomareva; ZEMLYA I VSELENNAYA, No 1, Jan-Feb 86).....	22
Structure of North Sea Sector of Middle European Plate (R.G. Garetskiy, V.Ya. Kozhenov; BYULLETKEN MOSKOVSKOGO OBRASHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY, No 2, Mar-Apr 86).....	23
Two-Layer Structure of Magnetically Active Layer of Oceanic Lithosphere (E.M. Litvinov, E.A. Vaniyeva; MYULLETKEN MOSKOVSKOGO OBRASHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY, No 2, Mar-Apr 86).....	24
Capture and Transport of Fragmentary Material by Okhotsk Sea Ice (Ye.I. Archikov, L.Ye. Stepanova; TIKHOKEANSKAYA GEOLOGIYA, No 1, Jan-Feb 86).....	24
Composition and Structure of Manganese Encrustations in Sea of Japan (L.Ye. Shterenberg, V.A. Aleksandrova, et al.; TIKHOKEANSKAYA GEOLOGIYA, No 1, Jan-Feb 86).....	25
Method of Search for an Exploration of Marine Oil and Gas Deposits (I.I. Khvedchuk; TIKHOKEANSKAYA GEOLOGIYA, No 1, Jan-Feb 86).....	26
Magmatism and Atlantic Thermal Springs; Second Cruise of Scientific Research Vessel 'Akademik Boris Petrov' (L.V. Dmitriyev; VESTNIK AKADEMII NAUK SSR, No 4, Apr 86).....	26
Volcanism of Reykjanes Ridge (A.I. Almukhamedov, M.I. Kuzmin, et al.; GEOLOGIYA I GEOFIZIKA, No 3, Mar 86).....	27
Ferromanganese Formations of Submarine Slopes of Kurile Islands Arc (G.M. Gavrilenko, S.V. Khramov; VULKANOLOGIYA I SEYSMOLOGIYA, No 2, Mar-Apr 86).....	28

Raman Spectra of Small Water Clusters (M.A. Buldakov, I.I. Matrosov, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 86).....	28
Geological Structure and Development of Sierra Leone Submarine Rise (Equatorial Atlantic) (V.I. Kara, V.A. Lebedev; BYULLENTEN MOSKOVSKOGO OБSHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY, No 3, May-Jun 86).....	29
Characteristics of Suspended Matter and Processes of Modern Sedimentation in Eastern Gulf of Finland (L.K. Barkov, A.V. Budarkov, et al.; VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA, No 1, Mar 86).....	30
Reaction of Ocean to Typhoons Moving at Various Speeds (Numerical Experiments) (R.G. Grigorkina, Yu.A. Chistyakov; VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA, No 1, Mar 86).....	30
Relationship Between Morphology and Chemical Composition of Nobdules and Composition of Surrounding Sediment (P.I. Piven, P.A. Vaganov, et al.; VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA, No 1, Mar 86).....	31
Dynamics of Ice Cover in Weddell Sea During 1980 (V.V. Golosov; VESTNIK LENINGRADSKOGO UNVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA, No 1, Mar 86).....	32
Available Potential Energy in Upper Layer of World Ocean V.S. Arsenyev, V.A. Burkov; DOKLADY AKADEMII NAUK SSR, No 4, Apr 86).....	32
Magnetic Properties of Oceanic Borehole Basalts of Woring Plateau (I.V. Kashinskaya, K.V. Popov, et al.; VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA, No 2, Mar-Apr 86).....	33
Formation of Periodic Structures Upon Lateral Convection in Salt Water (V.M. Blinkov, A.M. Gusev; VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA, No 2, Mar-Apr 86).....	33
Transfer of Ozone by Middle Atmosphere Currents (M.S. Rakova, A.Kh. Khrgian; VESTNIK MOSKOVSKOGO UNITERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA, No 2, Mar-Apr 86).....	34

Achievements of Atlantic Ocean Studies (Ye.F. Shnyukov; GEOLOGICHESKIY ZHURNAL, No 3, May-Jun 86).....	34
Moisture Content of Recent Bottom Sediments of Northwestern Coastal Shelf of Guinea (V.A. Yemelyanov, N.L.M. Sakk, GEOLOGICHESKIY ZHURNAL, No 3, May-Jun 86).....	35
Structure of Magnetic Fields Induced by Linear Insulated Wire Immersed in Sea Water (A.G. Karpenko, L.A. Lobachevskiy, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, May 86).....	36
Polymers That Decrease Hydrodynamic Resistance and Certain Hydrodynamic Problems of Atherosclerosis (M.V. Kameneva, A.S. Parfenov; DOKLADY AKADEMII NAUK SSSR, No 3, May 86).....	36
Interaction of Synoptic Vortices of Finite Amplitude (G.G. Sutyrin, I.G. Yushina; DOKLADY AKADEMII NAUK SSSR, No 3, May 86).....	37
Spatial Correlation of Surface Noise in Acoustic Waveguide (S.S. Abdullayev, B.A. Niyazov, et al.; DOKLADY AKADEMII NAUK SSSR, No 1, May 86).....	37
Acoustic Noise Theory for Randomly Inhomogeneous Ocean (O.E. Gulin, V.I. Klyatskin; DOKLADY AKADEMII NAUK SSSR, No 1, May 86).....	38
Point Eddies on $\beta$ -Plane and Solitary Rossby Waves (G.M. Reznik; OKEANOLOGIYA, No 2, Mar-Apr 86).....	39
Singular Geostrophic Eddies on $\beta$ -Plane as Model of Synoptic Eddies (V.M. Gryank; OKEANOLOGIYA, No 2, Mar-Apr 86).....	39
Research on Macroscale Circulation in Atlantic Sector of Antarctic Ocean (V.V. Guretskiy; OKEANOLOGIYA, No 2, Mar-Apr 86).....	40
Synoptic Variability of Water Temperature and Salinity in Canaries Upwelling (V.I. Voytov, V.M. Zhurbas; OKEANOLOGIYA, No 2, Mar-Apr 86).....	41
Transport and Mixing of Ocean Waters in Synoptic Eddy Field According to Polymode Data (N.A. Maksimenko; OKEANOLOGIYA, No 2, Mar-Apr 86).....	41

Spectrum of Energy Flux to Waves (D.V. Chalikov; OKEANOLOGIYA, No 2, Mar-Apr 86).....	42
Seasonal Variability of Thermal Structure of Upper Ocean Layer in Polymode Region (I.M. Belkin, B.N. Filyushkin; OKEANOLOGIYA, No 2, Mar-Apr 86).....	43
Forms of Presence of Iron and Manganese in Waters of Peter the Great Bay (Sea of Japan) (N.N. Bogdanova, V.M. Shulkin; OKEANOLOGIYA, No 2, Mar-Apr 86).....	43
Application of Ellipsometry in Studying Oil Slicks on Sea Surface (K.S. Shifrin, Yu.V. Villevalde, et al.; OKEANOLOGIYA, No 2, Mar-Apr 86).....	44
Mass Species of Oceanic Herbivorous Copepods in World Ocean and Their Ecological Features (A.K. Geynrikh; OKEANOLOGIYA, No 2, Mar-Apr 86).....	45
Plankton in Lower Layers of Black Sea Oxygen Zone (M.Ye. Vinogradov, E.A. Shushkina, et al.; OKEANOLOGIYA, No 2, Mar-Apr 86).....	46
Principles for Automation of Simulation in Biooceanology: Event Approach Concept (M.V. Galperin; OKEANOLOGIYA, No 2, Mar-Apr 86).....	46
Dynamic Characteristics of VDK Sensor for Measuring Velocity (S.Yu. Kuznetsov, N.S. Speranskiy; OKEANOLOGIYA, No 2, Mar-Apr 86).....	47
Research in the Tropical Atlantic (Twenty-Ninth Cruise of Scientific Research Ship 'Akademik Vernadskiy') (N.N. Karnaushenko, V.A. Gayskiy, et al.; OKEANOLOGIYA, No 2, Mar-Apr 86).....	48
Comprehensive Geophysical Research on Fourth Voyage of Scientific Research Ship 'Rift' (V.N. Moskalenko, L.G. Akentyev, et al.; OKEANOLOGIYA, No 2, Mar-Apr 86).....	49
Method for Computing Wave Pressure Forces Operative on Sea Drill Rig Jig (S.S. Khvorostovskiy; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA, No 5, May 86).....	50
Filtering in Marine Gravimetry Problems (V.L. Panteleyev; METROLOGIYA, No 1, 1986).....	50

Role of Biological Productivity of Waters in Forming Nodular Ores on Ocean Floor (N.S. Skornyakova, I.O. Murdmaa, et al.; DOKLADY AKADEMII NAUK SSR, No 2, May 86).....	51
Some Drift Patterns of Sofar Floats in Synoptic Eddy Field (V.N. Yeremeyev, L.M. Ivanov, et al.; DOKLADY AKADEMII NAUK SSSR, No 2, May 86).....	52
Spatial-Temporal Analysis of Sea Surface Photoimages (V.M. Burdyugov, S.A. Grodskiy, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	53
Experimental Research on Three- and Four-Wave Resonant Interactions of Surface Sea Waves (I.I. Strizhkin, V.I. Raletnev; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	53
Long Essentially Nonlinear Waves in Rotating Ocean (V.I. Shrira; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	54
Development of Region of Partially Mixed Fluid in Fine-Structured Stratified Medium (V.A. Popov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	55
Dissipation of Turbulent Energy in Layer of Ocean Wind Waves (A.V. Solov'yev; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	56
Quasi-Homogeneous Model of Evolution of Turbulent Wake Region Behind Body in Stratified Medium (L.I. Skurin; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	56
<b>TERRESTRIAL GEOPHYSICS</b>	
Underground Water Can Be Seen (DOMESTIC SERVICE, 24 Apr 86).....	58
Fossil Finds by Siberian Paleontologists Add to Understanding of Life Development Chronology (TASS, 6 May 86).....	59
New Mineral Found in USSR (TASS, 4 Jun 86).....	60

Forum Participants Comment on U.S. Seismologists at Semipalatinsk (A.Belikov, N. Zhelezov; SOVETSKAYA ROSSIYA, 15 Jul 86).....	61
Kola Superdeep Borehole Described (Ye.A. Kozlovskiy; ZEMLYA I VSELENNAYA, No 1, Jan-Feb 86).....	63
Theoretical Seismograms of Surface Seismic Waves in Anisotropic Media (Ye.M. Chesnokov, S.S. Abashev; DOKLADY AKADEMII NAUK SSSR, No 3, 1986).....	64
Use of Seismic Noise in Study of Lithosphere (A.V. Nikolayev, P.A. Troitskiy, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, 1986).....	64
Entrainment of Sediments to Great Depths Under Continents (A.S. Monin, O.G. Sorokhtin; DOKLADY AKADEMII NAUK SSSR, No 3, 1986).....	65
Some Features of Structure of Oceanic Crust in Example of Brazilian Basin (V.G. Kazmin, O.V. Levchenko, et al.; GEOTEKTONIKA, No 2, Mar-Apr 86).....	66
Stages in Tectonic Transformations in Northwestern Pacific Ocean and Its Continental Margin (Ye.N. Melankholina; GEOTEKTONIKA, No 2, Mar-Apr 86).....	66
Tectonic Conditions Favoring Presence of Petroleum and Gas in Sedimentary Basins of Marginal Zones of Continents (Yu.K. Burlin, N.A. Krylov, et al.; GEOTEKTONIKA, No 2, Mar-Apr 86).....	67
Sesimogeology, Geophysical Fields of Mongolian-Okhotsk Seismic Zone and Problems in Earthquake Prediction (V.P. Solonenko; GEOLOGIYA I GEOFIZIKA, No 2, Feb 86).....	68
Features of Distribution of Salt Structures in Dnepr-Donets Depression (N.I. Galabuda, B.I. Malyuk; GEOLOGICHESKIY ZHURNAL, No 1, Jan-Feb 86).....	69
Argillaceous Minerals of Volcanogenic Rocks in Saatly Superdeep Hole SG-1 (A.G. Seidov, M.B. Kheirov; IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE, No 1, Jan-Feb 86).....	69

Increased-Response Channel for Regional Seismic Station (Yu.V. Shevchenko, B.I. Sennikov, et al.; VULKANOLOGIYA I SEYSMOLOGIYA, No 1, Jan-Feb 86).....	70
Seismic Activity in Zone of Baykal-Amur Railroad Line (V.M. Kochetkov, N.A. Gileva; VULKANOLOGIYA I SEYSMOLOGIYA, No 1, Jan-Feb 86).....	71
Lena-Tunguska Province: Promising Region for Organizing New Petroleum and Gas Production Base in Eastern USSR (A.E. Kontorovich, M.M. Mandelbaum, et al.; GEOLOGIYA I GEOFIZIKA, No 1, Jan 86).....	72
Multiwave Seismic Prospecting in Solving Problems in Predicting Geological Section in Western Siberia (N.N. Puzyrev, G.V. Vedernikov; GEOLOGIYA I GEOFIZIKA, No 1, Jan 86).....	72
Geoacoustic Precursor of Transcarpathian Earthquakes of 5 October 1983 (T.Z. Verbitskiy, B.D. Boyko; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI, No 4, Apr 86).....	73
Results of Geophysical Study of Sakhalin-Kurile Islands- Pacific Ocean Profile (A.N. Petrov, I.S. Mazurova; VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA, No 2, Mar-Apr 86).....	74
Biogeochemical Exploration in Eastern Uzbekistan (V.F. Skryabin; RAZVEDKA I OKHRANA NEDR, No 4, Apr 86).....	75
Desertification - Global Ecological Problem (N.S. Orlovskiy; VOPROSY FILISOFII, No 2, Feb 86).....	75
Meteorological Precursors of Major Earthquakes (M.R. Milkis; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI, No 3, Mar 86).....	76
Laser Interferometer for Deformographic Observations in Surkhob Tectonic Fault Region (V.A. Aleshin, A.S. Gorshkov, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI, No 3, Mar 86).....	77
Electromagnetic Radiation of Fracture Surface During Destruction of Ion Crystals (N.I. Gershenzon, D.O. Zilpimiani, et al.; DOKLADY AKADEMII NAUK SSSR, No 1, Jan 86).....	78

Phenomenon of Hydrocarbon Generation From Hyperoxidized Compounds of Carbon and Water (N.V. Cherskiy, V.P. Melnikov, et al.; DOKLADY AKADEMII NAUK SSSR, No 1, Jan 86).....	78
Calculation of Derivative $\Delta T$ Anomalies Using Measurements of Along-Course Gradients in Modulus of Earth's Magnetic Field Strength (V.M. Gordin, V.O. Mikhaylov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI, No 2, Feb 86).....	79
Results of Geomagnetic Research in Epicentral Zone of Nazarbek Earthquake of 11 December 1980 (Yu.P. Tsvetkov, K.N. Abdullabekov, et al.; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	80
Deep Electrical Conductivity Model Based on Generalized Global Sounding Results (V.I. Dmitriyev, N.M. Rotanova, et al.; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	80
<b>PHYSICS OF ATMOSPHERE</b>	
Optimal-Microstructural Characteristics of Soil Aerosols (L.P. Dinmukhametova, I.A. Mogilyuk, et al.; IZVESTIYA AKADEMII NAUK: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	82
Evaluating Nonlinear Effects in Propagation of Acoustic Pulse in Atmospheric Surface Layer in Inversions (I.P. Chunchuzov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	82
Experimental Research on Turbulence in Upper-Level Tropospheric Clouds (V.K. Dmitriyev, T.P. Kapitanova, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 86).....	83
Solar Control of Geophysical Phenomena (V.F. Loginov, G.V. Fedorovich; ZEMLYA I VSELENNAYA, No 1, Jan-Feb 86).....	84
Effect of Pulsating Auroras on Frequency-Time Characteristics of Radio Signals Reflected From Auroral Ionosphere (A.A. Arykov, I.N. Bardeyev, et al; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	85
Phase Fluctuations of Ionosphere Radio Signals (V.D. Gusev, M.B. Vinogradova; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	85

Transverse Resonances of Earth-Ionosphere Wave Guide in Auroral Region (V.S. Smirnov, A.A. Ostapenko; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	86
Regular Noise Background in VLF-Radiation and World Thunderstorm Centers (G.I. Druzhin, T.V. Toropchinova, et al.; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	87
Spatial Radio Wave Attenuation During Vertical Sounding of Ionosphere (P.F. Denisenko, V.I. Vodolazkin, et al.; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	87
Effects Occurring During Electromagnetic Field Reception Near Powerful Heat Current (V.N. Kunin, M.S. Aleksandrov, et al.; GEOMAGNETIZM I AERONOMIYA, No 2, Mar-Apr 86).....	88
Radiation Density and Absorption in Vertically Inhomogeneous Atmosphere With Underlying Surface (L.M. Romanova; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 4, Apr 86).....	88
<b>ARCTIC AND ANTARCTIC RESEARCH</b>	
'SP-28' Arctic Station in Operation (SOVETSKAYA ROSSIYA, 22 May 86).....	90
Ships Return From Antarctica (DOMESTIC SERVICE, 22 May 86).....	91
IL-18D Airplane Outfitted for Research in Antarctica (V. Belikov; IZVESTIYA, 23 Jul 86).....	92
Research Ship 'Professor Zubov' Returns From Antarctica (T. Volgina; LENINGRADSKAA PRAVDA, 21 May 86).....	93
IL-76md Airplanes Drop Cargo and Personnel at Arctic Station (S. Nechayuk; KRASNAYA ZVEZDA, 24 May 86).....	94
New Search-and-Rescue Equipment Tested in Arctic Exercise (V. Gusanov; TRUD, 30 May 86).....	95
Proposals for Advancement of Year-Round Arctic Shipping (L. Timokhov, N. Mustafin; VODNYY TRANSPORT, 22 May 86).....	96

Coal Gas Migration in Permafrost Regions  
(V.V. Shershukov, V.N. Khudyakov; SOVETSKAYA  
GEOLOGIYA, No 5, May 86)..... 97

History of Relief Development on Shelf in Eastern Soviet  
Arctic  
(A.P. Puminov; SOVETSKAYA GEOLOGIYA, No 5, May 86)..... 98

/13046

METEOROLOGY

DEVICE FOR VIOLENT WEATHER STUDY BASED ON THERMODYNAMIC CHANGE

Leningrad LENINGRADSKAYA PRAVDA in Russian 29 Apr 86 p 1

[Article by O. Nosareva]

[Text] An apparatus developed at the Hydrometeorological Institute will make it possible to obtain more accurate information about violent and rapid natural processes such as thunderstorms, hail and downpours.

"All large-scale natural phenomena," said S.S. Mkrtchyan, a post-graduate student at the chair of experimental atmospheric physics, "are accompanied by specific changes in the atmosphere's thermodynamic equilibrium. Our task is to clarify precise regularities involved in these changes. This will enable us to determine the parameters of the processes occurring and, consequently, to predict them more accurately."

The apparatus, which received high praise at the Leningrad Exhibit of Scientific and Technological Creative work by Students, is already being used at the institute for scientific and instructional purposes. Students use it for laboratory and course work and for diploma projects.

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## INTERNATIONAL CONFERENCE ON AIR POLLUTION MODELING

Leningrad LENINGRADSKAYA PRAVDA in Russian 20 May 86 p 3

[Abstract] An international conference on modeling of pollution of the atmosphere began its work yesterday in the conference hall of the Hotel Pulkovo. The main topics of the conference are the latest methods for the study of monitoring and control of the atmosphere's composition inside national boundaries and on a global scale, and forecasting the purity of the atmosphere with the aid of special mathematical models. Representatives of research centers from more than 20 countries of Europe, Asia, Africa and America have gathered at this meeting of scientists, which was organized by the World Meteorological Organization with support from the United Nations Organization and the USSR State Committee on Hydrometeorology and Monitoring of the National Environment.

Opening the conference, Professor Ye. Borisenkov, director of the Main Geophysical Observatory imeni Voyeykov, noted that the problem of protecting the environment against pollution is now taking on the greatest social and economic importance, both for individual countries and on the international level, and it is a most important component of the global problem of nature conservation. He noted that a law on the protection of atmospheric air is in effect in the Soviet Union. This law imposes strict requirements on ministries, agencies and enterprises. A lowering of the level of atmosphere pollution has been noted lately. A large volume of work in this direction is being done in Leningrad, and thanks to this work, it is now possible to include this city among the cleanest of its size in the world.

The conference will last until May 24.

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CSO: 1865/280

## INSTITUTE'S WORK ON RAINFALL MODIFICATION IN CHERNOBYL AREA

Kiev PRAVDA UKRAINY in Russian 24 May 86 p 3

[Article by T. Larina, correspondent]

[Abstract] A report was received from the Ukrainian Hydrometeorological Center that a front of thunderstorm clouds was moving toward Kiev Oblast. There was a possibility of heavy showers. Weather forecasters of the Ukrainian Hydrometeorological Scientific Research Institute of the USSR State Committee on Hydrometeorology and Monitoring of the Natural Environment (Goskomgidromet) who received this information immediately went to work analyzing the situation. One or even all of the airplanes at the scientists' disposal would be flown if necessary.

"Scientists and specialists have been working for a long time on problems of actively modifying the weather," said Professor V.S. Maksimov, director of the institute.

Scientific work in this direction has been in progress at the institute for about 20 years. Methods which have been developed allow the amount of rainfall to be controlled to a certain degree. These methods call for the use of carbonic acid--dry ice, to use the more familiar term.

This work has proved very useful now that specialists face the task of preventing, insofar as possible, rain from falling in the immediate future on the area contaminated with radioactive elements in the vicinity of the Chernobyl Nuclear Power Station. The purpose of this is to prevent radionuclides from escaping from this area together with storm runoff.

This is why associates of the institute and colleagues from USSR Goskomgidromet's Central Aerological Observatory are constantly on duty, keeping a sharp eye on meteorological conditions in the oblast and preventing cumulus clouds from developing by forcing them to release rain for brief periods on the approaches to the contaminated locality. A 'squadron' of the weather service worked for all the daylight hours on 20 May, for example. About 90 cloud cells were destroyed, which helped to break up the cloud cover. This work will be conducted intensively until decontamination of the contaminated sectors is completed.

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## METEOROLOGICAL EFFECTS OF GEOTECTONIC PHENOMENA HYPOTHEZIZED

Riga SOVETSKAYA LITVA in Russian 27 Apr 86 p 2

[Article by G. Afanasyev]

[Abstract] Where is the 'kitchen of the weather' located? In the earth's mantle. This is the unexpected answer to this question which has been offered by Soviet researchers Igor Yanitskiy and Eduard Borodzich. They support their hypothesis with rather compelling arguments.

When meteorological data for several years in succession are carefully analyzed, an interesting regularity comes to light: heightened or lowered atmospheric pressures are observed more frequently over certain regions of the planet than others. Moreover, cyclones and anticyclones originate in these same regions.

There must be some cause or mechanism which gives rise to this effect.

The natural conclusion, however unlikely it may seem, is that the source of the weather is located in the depths of the planet, in its mantle.

Yanitskiy and Borodzich stated their hypothesis publicly in January of this year, at a conference on geotectonics which took place at the USSR Academy of Sciences' Geology Institute. The hypothesis was so extraordinary that its authors were literally showered with questions.

"How do you understand the mechanism by which the mantle produces effects on the atmosphere?"

"When the mantle interacts with the earth's core, so-called mantle channels form. They are, roughly speaking, fluctuating columns of matter 25-30 kilometers in diameter and 2,900 kilometers tall. This leads to the appearance of gravitational anomalies which are, to be sure, too weak to affect molecules of air directly, but they are quite sufficient to alter, by 1,000 times or more, the concentration of aerosols--droplets of water about 0.2 micrometer in diameter which are suspended in the air. These aerosols are condensation centers for water vapors, and their concentration directly affects the weather, as meteorologists demonstrated long ago. If the concentration changed in a certain place, the heat balance of the atmosphere also

changed there; areas of heightened or lowered pressure occurred, and a cyclone or anticyclone was formed."

"And did you check whether the weather centers you discovered in the atmosphere remain in the same places, as they should if they are connected with mantle channels?"

"We did; they are 'nailed in place'."

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THIRD INTERNATIONAL SYMPOSIUM ON TROPICAL METEOROLOGY (YALTA, 24-31 MARCH 1985)

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 2, Feb 86 pp 221-223

[Article by V.N. Ivanov]

[Abstract] The Third International Symposium on Tropical Meteorology was held at Yalta during the period 24-31 March 1985. The 100 specialists present represented scientific institutes in the USSR, Cuba and Vietnam. Twelve special reports and 18 other communications were presented on the subject of tropical meteorology and hurricane research. The subjects dealt with included prediction of the trajectories of tropical cyclones, generation and development of tropical cyclones, numerical and laboratory modeling of tropical cyclones, structure and energetics of tropical cyclones, clouds and artificial inducement of precipitation. Three types of prognostic models (hydrodynamic, statistical and semiempirical) were discussed. It was recommended that work be continued on improving prognostic models of different types with use of different methods. There are new physical concepts of generation of tropical cyclones which must be further developed: the turbulent mechanism of generation of a macroscale eddy with a non-zero value on the spiral invariant and the concept of an unstable shear flow resulting in the appearance of eddy structures. Additional work must be done on the mathematical modeling of tropical cyclones, especially development of three-dimensional models of evolution of tropical cyclones and joint models of evolution and movement of tropical cyclones. There is a further need for models of individual processes and phenomena in tropical cyclones, including convection and processes in the boundary layer. Methods for the initialization and assimilation of observational data require further development. There is need for new laboratory models of tropical cyclones for study of the fundamental physical mechanisms responsible for the generation, evolution, structure, energy exchange and conditions for the development of eddy structures in shear flows. Data banks on tropical cyclones must be expanded, with full incorporation of data from meteorological satellites, radars and aircraft laboratories.

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SHARP ENHANCEMENT OF PRECIPITATION INTENSITY ACCOMPANYING GRAVITATIONAL COAGULATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 2, Feb 86 (manuscript received 11 Nov 84) pp 160-168

[Article by V.M. Voloshchuk, Experimental Meteorology Institute]

[Abstract] A highly simplified mathematical model of cloud microstructure was formulated which served as a basis for a four-parameter model of the precipitation formation process. This model takes into account the enlargement of particles by condensational growth, the paired coagulation of cloud particles and their elimination by precipitation nuclei, as well as the sedimentation of large particles exceeding a stipulated size. It was found that with the passage of time a cloud is always transformed into a state in which the intensity of formation of large particles experiences a sharp enhancement, a state with a clearly expressed jump in precipitation intensity. The characteristics of real clouds were used in making numerical estimates which revealed that for a rather large class of clouds the time required for transition to a state with a jump in the intensity of formation of precipitation is comparable to the characteristic lifetime of these clouds. Figures 2; references 4: 3 Russian, 1 Western.

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STATUS OF RESEARCH ON ANTHROPOGENIC CLIMATIC CHANGES

Obninsk GIDROMETEOROLOGIYA. SERIYA 37.21, METEOROLOGIYA in Russian No 2, 1986 (signed to press 21 Apr 86) pp 1-55

[Monograph by M.I. Budyko, State Hydrological Institute]

[Abstract] The book is a review and integration of the literature on natural factors responsible for climatic change, changes in the chemical composition of the atmosphere, anthropogenic factors involved in recent climatic change and means for detecting such anthropogenic changes. The information considered therefore includes such subjects as the secular variation of air temperature anomalies, secular variation of the meridional temperature gradient, secular variation of ice content in the Greenland Sea and ice area in the Arctic Ocean, secular variation of precipitation falling in the steppe and wooded steppe zones of the USSR, changes in atmospheric concentration of carbon dioxide during the period 1958-1980, calculations of anticipated changes in total anthropogenic discharge of CO<sub>2</sub> into the atmosphere up to the year 2100, secular variation of direct radiation and mean air temperature in northern hemisphere, mean temperature anomalies in northern hemisphere during

the period 1880-1960 and predictions of possible change in mean air temperature at earth's surface up to the year 2070. It is concluded that the combustion of fossil fuels is increasing the atmospheric content of carbon dioxide. The situation is aggravated by increases of freons, nitrogen oxides and other trace gases. These are enhancing the greenhouse effect and are resulting in a global change in climate in the direction of a warming. The progressive anthropogenic change in climate cannot be evaluated, however, without an assessment of changes attributable to natural factors. Such variations can be accounted for in large part by instability of atmospheric transparency due to variations in the mass of atmospheric aerosol associated with volcanic activity. Mean surface temperature has increased by 0.5°C during the last century under the influence of CO<sub>2</sub> and this trend can continue, resulting in serious changes in the pattern of precipitation such as have already been experienced in certain parts of the middle latitudes. Figures 13; references 89: 46 Russian, 43 Western.

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#### SYNCHRONOUS CHANGES IN ACTIVITY OF DANGEROUS PHENOMENA AND THEIR PREDICTION

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian No 3, May-Jun 86 (manuscript received 27 Jun 85) pp 23-30

[Article by B.L. Berri, S.M. Myagkov and V.S. Freydlin, Moscow University]

[Abstract] There are direct correlations between global changes in temperature and the frequency of avalanche and mudflow occurrence on the Eurasian continent. This conclusion is based on a comparison of the years characterized by anomalous deviations of temperatures and the activity of dangerous phenomena. The norms used were computed for periods of several decades and intervals of not less than 30 years were used in computing the statistical characteristics of climate. The thesis was tested using data on occurrence of mudflows in the years of greatest activity in different parts of the Caucasus and Central Asia (15 such periods of common mudflow behavior during the period 1889-1972 were defined). The analysis was made over an extensive area which included regions with different climatic conditions. These data were then compared with records for more distant regions, such as Norway and Scotland. It was found that the extrema on a graph approximating temperature in the northern hemisphere agree well with the dates of appearance of temperature anomalies of the Pacific Ocean surface in the equatorial zone (El Niño). It is evident that anomalous variations of meteorological elements cause an increase in avalanche and mudflow activity, droughts, fires, floods and other dangerous natural phenomena. All these changes could evidently be traced to common cosmic factors. Such information affords possibilities for a superlong-range prediction of dangerous climatogenic phenomena. The next significant increase in the number of dangerous events can be anticipated in the middle of the last decade of this century when there is a minimum of global temperatures. Figures 3; references 21: 18 Russian, 3 Western.

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OCEANOGRAPHY

NONMAGNETIC VESSEL 'ZARYA' BEGINS BLACK SEA CRUISE

Leningrad LENINGRADSKAYA PRAVDA in Russian 17 Jul 86 p 1

[Article by S. Nikonov]

[Text] The first "marine metrological test area" in world science will be charted in the Black Sea from the motor-and-sail schooner "Zarya."

The world's only totally nonmagnetic vessel is on its 29th research cruise. The leaders of the expedition radioed yesterday from the schooner that the "Zarya" had passed through the straits of Denmark on its way around Europe.

"The purpose of the Black Sea experiment is to make a series of measurements of the magnetic field in the waters between the coasts of Bulgaria and the USSR," explained Ye.N. Roze, senior science associate of the Leningrad branch of the Institute of Earth Magnetism, the Ionosphere and Propagation of Radio Waves, who is scientific director of the experiment. "These measurements will be so precise that they will allow the area to be used subsequently as a reference standard for checking new methods, instruments and apparatus. This is called for by the joint geophysical research program of the academies of sciences of member-countries of the Council for Mutual Economic Aid."

The cruise of the "Zarya" will last until October 30, after which the schooner (for the first time in its history) will not return to Leningrad but will remain in a Black Sea port to spend the winter.

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## OPTICAL TOMOGRAPH GIVES INSTANTANEOUS INTERFERENCE HOLOGRAMS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Jul 86 p 4

[Text] Red laser beams pierced the dimness of the laboratory, and at the same instant the air in front of us seemed to condense and to coalesce into a strange figure made up of dark and light bands. It was alive, changing and shimmering with an eery light.

"In effect, you have seen the invisible," explained Candidate of Physical-Mathematical Sciences G. Vishnyakov. "How drops of clear, cold water sink into water which is just as clear, but warm, forming eddies and currents. These experiments provide a key to an understanding of the mixing processes of layers of water in the ocean, on which, as is known, the variability of weather depends."

The holography unit developed by G. Levin and G. Vishnyakov, associates of the research-and-production association VNIIIFI, makes it possible to penetrate into an outwardly unnoticeable phenomenon and to isolate any layer of a transparent object, in a way similar to how a computer tomograph explores the brain and peers below the ground.

"The laser beam shines light through an object from different directions at the same time," said G. Levin, "and produces an entire set of holograms. Later on, the computer analyzes them and plots the phenomenon taking place."

"Yes, but we saw the interference image immediately, and not later on..."

"We were able to replace the digital computer with an optical one," explained the scientist. "With a system of lenses and mirrors, 'information processing' takes place literally at the speed of light."

The 'optical tomograph'--this is the name given by the scientists to their invention--gives, of course, only an approximate picture of a phenomenon. But its accuracy is quite sufficient for dynamic study of processes that before were inaccessible to the eyes of experimenters. The mixing experiments are but one example of the use of the unit. One can also peer into a flame, see how hot bodies radiate heat, how air flows around an airplane model or a turbine blade, and much more. Scientists have acquired another powerful tool for expanding knowledge.

(A photograph is given showing G. Vishnyakov.)

RESEARCH SHIP 'STRAKHOV' BEGINS ATLANTIC CRUISE

Moscow VODNYY TRANSPORT in Russian 27 May 86 p 1

[Text] The scientific research vessel "Nikolay Strakhov" has left the Kaliningrad seaport and is headed for the east-central region of the Atlantic Ocean. An expedition of scientists of the USSR Academy of Sciences' Geology Institute is on board. They are to begin a series of fundamental studies of the ocean floor.

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POLISH-BUILT RESEARCH SHIP 'FERSMAN' IN SERVICE

Moscow VODNYY TRANSPORT in Russian 27 May 86 p 1

[Text] The Soviet flag has been raised on the ship "Akademik Fersman," which workers of the Szczecin Shipyard imeni Warski built to order for the USSR.

Intended for geophysical studies, this vessel is outfitted with unique equipment which will make it possible to study the depths of the world's oceans comprehensively and to prospect deposits of minerals in any latitudes. Comfortable conditions have been created for the crew's work and recreation during cruises in both polar and tropical seas.

The "Akademik Fersman" is the 180th vessel which the Szczecin shipyard has built for the Soviet Union.

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SHIPBOARD NUCLEAR ANALYTICAL COMPLEX FOR MINERAL PROSPECTING

Moscow TRUD in Russian 13 May 86 p 1

[Article by V. Bratchikova (Vladivostok)]

[Text] A development of Far East scientists opens up new possibilities in the prospecting and study of mineral resources of the world's oceans. They have developed the country's first onboard nuclear analytical complex.

Installed on the scientific research vessel "Geolog Petr Antropov" of the USSR Ministry of Geology, the complex has been tested during a sea expedition. This promising method of analysis can be used for determining the element composition of ore of the future, as ferromanganese nodules on the ocean floor are called.

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CSO: 1865/325

## IL-18 METEOROLOGICAL LABORATORY AIRPLANE

Moscow VOZDUSHNYY TRANSPORT in Russian 29 May 86 p 3

[Text] Since the birth of aviation, airplanes have become an effective aid to study of the atmosphere. An IL-18 has been turned into a laboratory airplane which hunts cyclones, figuratively speaking. Installed on board this airplane is special meteorological apparatus for measuring thermodynamic, radar and cloud parameters of the atmosphere.

The "Tsiklon" [as the airplane is called] is intended for solving a large complex of problems connected with atmospheric research. One of these problems is the study of processes occurring in clouds, which must be understood in order to accomplish important economic tasks connected with the regulation of precipitation: increasing harvests, reducing rainfall over industrial centers and, lastly, creating good weather where and when it is desired.

(Three photographs are given showing a pilot at the controls of the IL-18 laboratory airplane; research equipment in a bay of the airplane; and the airplane on the ground. A long rod extends from the nose of the airplane; it is explained that measuring devices installed on this rod, far ahead of the fuselage, make it possible to determine atmospheric parameters in an undisturbed air flow.)

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CSO: 1865/347

## WORK WITH SMALL SUBMERSIBLE CRAFT 'OKEANOLOG' IN FAR EAST

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 May 86 p 4

[Text] A small white deckhouse disappeared beneath the waves of the Sea of Okhotsk: a miniature submersible craft, the "Okeanolog," had begun operating. It is the first craft of its kind in the Far East. Its crew has the task of inspecting foundations of offshore drilling rigs at oil fields of Northern Sakhalin, and of finding level areas for new platforms.

The operation of equipment at offshore oil fields in the past was supported by divers, and this was difficult work. Managers of Sakhalin Island oil fields have therefore chartered the "Okeanolog" from the Far East Oceanology Institute of the USSR Academy of Sciences' Far East Research Center. This craft's four screw propellers enable it to maneuver in a very small space. Its six windows provide a good field of vision, and its mechanical arm is capable of gathering soil samples and moving underwater objects.

The "Okeanolog" will be used also for scientific studies of the Sea of Okhotsk.

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## INSTITUTES INVOLVED IN AEROSPACE PHOTOGRAPHY OF SEAS

Moscow PRAVDA in Russian 14 Jul 86 p 3

[Article by V. Shirokov]

[Excerpt] Not long ago a whole 'crew' of cosmonauts got together in Tallin. The occasion was a conference of the "Interkosmos" [council's] working group on remote probing of the earth. Sigmund Jaehn, Georgi Ivanov, Bertalan Farkas and other participants of international space programs are well-acquainted with Leonid Kizim and Vladimir Solovyev, who during the current mission have worked on two orbiting stations. The cosmonauts in Tallin had high praise for their work. It should be noted that an extension of this [mission's] work is being performed by persons who are not so far off from the land and water, who are conducting observations on the bottom level of the aerospace 'etagere.'

Yak Feliksovich Lokk talked about flights over the sea in a helicopter. Results of remote probing, which is a task of his group in the Baltic Sea department of the Estonian Academy of Sciences' Institute of Thermophysics and Electrophysics, are reflected in photographs, spectral analyses, charts, graphs and figures.

In what way is the Baltic Sea an object of their studies? The study of it is carried out on three levels: from spacecraft, from airplanes and helicopters, and on the water's surface.

The Estonian remote probing group cooperates closely with the Leningrad Branch of the State Oceanographic Institute, which has assumed a large part of the research in the infrared range of the spectrum. Lokk and his colleagues interpret video information. As a result, they jointly carry out basic aerospace surveying of the Baltic Sea. There is also a growing partnership with the Ukrainian Academy of Sciences' Marine Hydrophysics Institute, which possesses a wealth of experience in studying the Black Sea, using radiophysical methods. Obtaining pictures in different spectral ranges from space, from helicopters and airplanes, and at the water surface by the contact method, they are able to determine according to color and contrast of the pictures which layer of water is being viewed and what substances it contains.

For many users, it is important to know the quality of the water. On the basis of hues and shades, which depend on substances dissolved in the water, the Estonian scientists are able to track the spreading of these substances in the sea, as well as their dilution and mixing. It is possible to determine how harmful substances spread and where. In sum, results of long-distance probing can be utilized in many different branches of the economy.

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## WORK ON RESONANCE ROBOTS WITH LOW POWER CONSUMPTION

Moscow VECHERNYAYA MOSKVA in Russian 26 May 86 p 2

[Article by I. Ivanov]

[Abstract] Instead of stamps or postcards, T. Akinfiyev, science associate of the USSR Academy of Sciences' Institute of Machine Studies, collects robots he has designed himself. All of them are based on principles of auto-resonance, i.e., their own movements are made without energy supplied from outside. Miniature motors no larger than a matchbox and having capacities of only 3-4 watts merely make up the power losses of the robots' vibratory systems from friction, whereas foreign-made manipulators intended for similar purposes consume more than 100 watts.

Of the ten original designs in this collection, which is housed in a laboratory of the institute, only one robot is distinguished by conventional appearance. Several bolts and nuts were in a small box in front of this manipulator. Working vigorously, it sorted them into various receptacles in a matter of seconds.

"It is not equipped with any force sensors or photocells," explained the designer. "The thing is that the frequencies of a resonance robot's own vibrations change as the mass which it carries increases or decreases. I have used this phenomenon for 'weighing' loads without the aid of special sensors, by endowing manipulators with this 'mechanical sense of touch'."

It was difficult to guess that a structure standing next to the manipulator on the table was also a resonance robot. It resembled the antenna of a peculiar insect, only it was about half a meter long. The four jointed metal segments of this 'antenna' are so designed that they 'recharge' each other with kinetic energy while operating, and the robot's small electric motor is needed only to compensate for friction. Moreover, each segment of this robot can carry a load independently of the operation of the rest.

Industry has become interested in T. Akinfiyev's works. Some of them are now being introduced at the "Krasnyy proletariy" machine-tool building plant in Moscow and at the Volga Automotive Plant.

The amount of electric energy that mechanisms consume can be reduced by 50-60 times by using the principles of the theory of resonance which is being perfected at the Institute of Machine Studies.

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EXAMPLE OF EDDY FORMATION IN STRATIFIED FLUID

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 2, Feb 86 (manuscript received 5 Mar 84, after revision 25 Oct 84)  
pp 211-215

[Article by V.N. Anuchin and V.A. Gritsenko, Kaliningrad Technical Institute  
of the Fishing Industry and Economy; Atlantic Division, Oceanology Institute,  
USSR Academy of Sciences]

[Abstract] An experimental study was made of the formation of eddies behind an obstacle generated by a shear flow in the bottom region. A laboratory experiment was carried out in a hydrodynamic glass flume. An obstacle was placed on the bottom at the center of the flume. The apparatus used for generating and studying the current is described in detail. Experiments were made with a uniform fluid and with a stable stratification. Several methods were used in visualization of the current; the current was registered simultaneously by a photosurvey using two cameras. The experiment revealed that the influence of an obstacle on the shear flow of a fluid can result in the formation of stable eddy formations of one fluid in the other. The velocity and pressure field behind the obstacle is deformed. In the studied case two large eddies were formed in the bottom region directly behind the plate; the velocity gradients change sign and there is a local vorticity whose rotational axis is normal to the bottom, with a region of reduced pressure appearing in this same zone. The proposed apparatus and method for observing the phenomenon are simple; unlike similar experiments in the past, there is no initial rotation of the entire fluid. In the future the method can be used in making contact measurements of the pressure and velocity fields and can provide quantitative criteria for instability of a stratified shear flow resulting in the formation of eddies of a heavy fluid in a light fluid. Figures 2; references 5: 4 Russian, 1 Western.

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ANALYSIS OF LAGRANGIAN STATISTICAL CHARACTERISTICS OF SYNOPTIC CURRENTS IN POLYMODE TEST RANGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 2, Feb 86 (manuscript received 11 Feb 85) pp 177-184

[Article by N.A. Maksimenko, Oceanology Institute, USSR Academy of Sciences]

[Abstract] The Lagrangian statistical characteristics of synoptic currents were investigated by computing the components of the Lagrangian correlation tensor of current velocity. This involved computing the trajectories of a great number of fluid particles, about 5,000 for each of four horizons. Data from 19 buoy stations were used during the period July 1977-August 1978 for measuring currents and water temperature at the horizons 100, 400, 700 and 1,400 m. These stations were situated amidst a grid of triangles centered at 29°N, 70°W. It was found that the correlation time was 3-4 days for both velocity components and for all four horizons. There is an approximately linear dependence of the coefficient of turbulent diffusion on the mean specific kinetic energy of the current synoptic component. In the test range the currents deviate little from geostrophic currents and the relative role of cyclonic eddies increases with depth in comparison with anticyclonic eddies. The POLYMODE currents can be interpreted as quasi-two-dimensional turbulence. Diffusion processes are anisotropic and diffusion predominates in the direction transverse to the mean current. The data made it possible to estimate the horizontal gradient of the turbulent diffusion coefficient. Figures 3; references 10: 9 Russian, 1 Western.

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KINETIC MODEL OF WIND WAVE GENERATION BY TURBULENT WIND

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 2, Feb 86 (manuscript received 6 Dec 83, after revision 10 Apr 85) pp 135-142

[Article by Yu.I. Nikolayeva and L.Sh. Tsimring, Applied Physics Institute, USSR Academy of Sciences]

[Abstract] In the quasi-laminar Miles approximation (J.W. Miles, J. FLUID MECH., Vol 2, No 5, pp 185-204, 1957) it was assumed that the air flow is laminar, although the mean wind velocity profile is determined by turbulent mixing processes. A shortcoming of such a quasi-laminar model is that wave disturbances of turbulent Reynolds stresses in the air are neglected. Attempts have been made to overcome this and other shortcomings, but these have been unsuccessful. Accordingly, a reexamination was made of the linear stage in

generation of waves on a water surface by the turbulent wind. The analysis was made on the basis of semiempirical equations for a single-point velocity distribution function in the air flow. This analysis revealed that the stipulation of the statistics of turbulent fluctuations at each point in the flow makes it possible to explain the observed excess of the increment of waves in the region of well-developed wind waves over the values indicated by the quasi-laminar Miles theory. It is admitted that the described collisionless kinetic model is a rather rough idealization because it takes into account the interaction of waves only with the large-scale energy-carrying components of the turbulence spectrum in the near-water atmospheric boundary layer. Figures 3; references 14: 5 Russian, 9 Western.

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#### HYDROTHERMAL-SEDIMENTARY AND HYDROTHERMAL ORE FORMATIONS OF WORLD

Moscow MORSKAYA GEOLOGIYA I GEOFIZIKA: GIDROTERMALNO-OSADOCHNYYE I GIDROTERMALNYYE RUDNYYE OBRAZOVANIYA V MIROVOM OKEANE in Russian 1985 (signed to press 10 Dec 85) pp 1-67

[Monograph by G.A. Cherkashev, S.G. Krasnov, B.Kh. Yegiazarov, A.I. Aynemer, A.M. Ashadze and A.Yu. Opekunov, All-Union Scientific Research Institute of Oceanic Geology and "Sevmorgeologiya" Geological Production Association, entitled "Hydrothermal-Sedimentary and Hydrothermal Ore Formations," Vsesoyuznyy nauchno-issledovatel'skiy institut ekonomiki mineralnogo syrya i geologorazvedochnykh rabot, 596 copies, 67 pages]

[Abstract] A total of 105 sources in the literature were reviewed for making a generalization of published data on hydrothermal and hydrothermal-sedimentary ore formation in the ocean genetically related to hydrotherms and on the tectonic conditions for ore formation. The factors exerting an influence on the nature of the ore formation process are also reviewed. All the presently known hydrothermal and hydrothermal-sedimentary ore shows in the ocean are listed together with their geographic location, geological position and composition (Table 1--26 pages). Another table (Table 2--20 pages) gives data on ore shows of hydrothermal-sedimentary and strictly hydrothermal genesis obtained during implementation of the oceanic drilling program from the "Glomar Challenger;" the table is based on materials in INITIAL REPORTS OF THE DEEP SEA DRILLING PROJECT, Volumes 1-70, 1970-1983. A 2-page map shows the geographical location of the tabulated hydrothermal and hydrothermal-sedimentary formations. The specific reasons for the differences in mineralogical composition of metal-bearing sediments, ore encrustations, massive ores and other manifestations of mineralization are discussed. Tables 2, figures 1: references 105: 25 Russian, 80 Western.

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SPATIAL VARIABILITY OF BAROCLINIC TRANSPORT OF WATERS BY ANTARCTIC CIRCUMPOLAR CURRENT

Leningrad IZVESTIYA VSESΟΥΖΝΟГО ГЕОГРАФИЧЕСКОГО ОБЩЕСТВА in Russian  
Vol 118, No 2, Mar-Apr 86 (manuscript received 20 Aug 85) pp 113-121

[Article by A.F. Treshnikov, V.N. Botnikov and S.B. Lesenkov, Leningrad]

[Abstract] Expeditionary data from the "Polyarnyy Yug" experiment during the last 10 years, supplemented by archival data, were used in representation of the mean position of boundaries of the Antarctic Circumpolar Current and the spatial variability of water discharges along its entire extent. The meridional boundaries of the current were determined by study of 43 sections of the vertical distribution of temperature, salinity and current velocity and 20 sections of temperature and salinity distribution alone. The boundaries of the current were plotted on a map which also shows the spatial variability of discharges in the current. The discharges were computed by the dynamic method. Water discharges were determined on 43 meridional sections (complete data are given in a table). The maximum discharges in the current were in March-April 1971 at meridian 0°; the smallest discharges were in Drake Passage. Water exchange between the Atlantic, Pacific and Indian Oceans occurs for the most part in the southern hemisphere with entrainment of waters from the Antarctic Ocean; thus, the Antarctic Circumpolar Current plays a very important role in the process of global water exchange. Figures 2; references 22: 7 Russian, 15 Western.

5303/13046  
CSO: 1865/317

SOVIET OCEANOGRAPHIC RESEARCH NEAR SEYCHELLES ISLANDS

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 86 pp 80-84

[Article by L.A. Ponomareva, doctor of biological sciences]

[Abstract] An expedition aboard the research ship "Professor Shtokman" operated in the Indian Ocean during the period November 1984-February 1985. This 13th cruise was devoted to biogeochemical research. Important research was done in the neighborhood of the Seychelles Islands. The studied area was characterized by many active zones and fronts separating ocean regions where biogeochemical processes transpire at different rates. Important results were obtained by laser sounding of the ocean for determining the spatial-temporal structure of the chlorophyll field and the field of organic matter dissolved in sea water. The content of organic matter was greatest near ports, in areas of river discharge and over shallow-water coral banks. The thin surface layer of water is on the average 15 times richer in biogenous elements than the deeper layers. In the surface layer the content of suspended organic carbon

is 6-10 times greater in both pelagic areas and in atoll lagoons. For the first time in the northwestern Indian Ocean and along the Red Sea it was possible to determine the content of atmospheric carbon dioxide; its content is not dependent on latitude, varying greatly in water and little in the air. The observations are still in the processing stage and will prove useful in the economy of the Seychelles, as well as in the economy of Madagascar, in whose waters similar observations were made. Figures 4.

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UDC 551.242.(261.26)

#### STRUCTURE OF NORTH SEA SECTOR OF MIDDLE EUROPEAN PLATE

Moscow BYULLETEN MOSKOVSKOGO OБSHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 61, No 2, Mar-Apr 86 (manuscript received 14 May 85) pp 20-26

[Article by R.G. Garetskiy and V.Ya. Kozhenov, Geochemistry and Geophysics Institute, Belorussian Academy of Sciences, Minsk]

[Abstract] The North Sea sector of the Middle European Plate is described on the basis of a synthesis of published materials (Fig. 1 is a map which most fully incorporates all newly available information). Until relatively recently little has been known concerning the structure of deposits more ancient than the Upper Permian (Zechstein) and the underlying basement because these rocks lie at great depths and have not been penetrated by drilling. It has become clear that the Zechstein deposits differ in the northern and southern parts of the sector, separated by sublatitudinal rises; in the northern part there are three major negative structures, in the southern part—one. Along the surfaces of Zechstein and Triassic rocks, like along the bottom of Zechstein deposits, there are similar downwarps and uplifts cut by a corresponding system of grabens; on the other hand, at the bottom of Cretaceous and more recent formations there is a quite simply structured submeridional syneclyse. In the structure of the North Sea grabens along the bottom of the Zechstein deposits there is a predominance of block structures, whereas along the surfaces of Zechstein and Triassic rocks there are mostly plicative-block structures, but along the bottom of Cretaceous and younger rocks it is plicative structures which predominate. Figures 2; references 21: 8 Russian, 13 Western.

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CSO: 1865/314

TWO-LAYER STRUCTURE OF MAGNETICALLY ACTIVE LAYER OF OCEANIC LITHOSPHERE

Moscow BYULLETEM MOSKOVSKOGO OБSHCHESTVA ISPYATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 61, No 2, Mar-Apr 86 (manuscript received 9 Oct 84) pp 56-63

[Article by E.M. Litvinov and E.A. Vaniyeva, All-Union Oceanology Scientific Research Institute, Leningrad]

[Abstract] The anomalous magnetic field of the Atlantic Ocean lithosphere is described, accompanied by a correlation and statistical analysis of the field along a system of sublatitudinal transoceanic profiles. The short- and intermediate-wavelength components are discriminated by filtering. The analysis was made using measurements of the total magnetic field vector. The results are illustrated, in particular, by the results obtained along one particular profile (along 28°20'N). In general, there is evidence that in the oceanic lithosphere there are at least two magnetically active horizons at different depths, with thicknesses different horizontally, with different magnetization and different genesis. The upper horizon has an inversion character, having been formed during spreading of the ocean floor, the magnetization of each of whose blocks corresponded to the magnetic field of the epoch of its formation (it is situated in the upper 2-km layer of the crystalline oceanic crust). The lower horizon, of metamorphic rock, has a thickness increasing uniformly from minimum values on the flanks of the mid-oceanic ridge to a definite maximum in abyssal basins. The magnetization of such formations occurs under the influence of the earth's field and the field of the upper magnetically active horizon. Over a considerable part of the Atlantic Ocean the lower magnetically active horizon makes a significant contribution to the anomalous magnetic field. The correlation and statistical method used in this research is recommended for study of the deep structure of the oceanic magnetically-active layer. The fact that the second horizon appears to be associated with the lower part of the crust and related directly to the Moho affords considerable possibilities for using magneto-metric data in studying deep structure of the ocean floor. Figures 4; references 14: 9 Russian, 5 Western.

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CAPTURE AND TRANSPORT OF FRAGMENTARY MATERIAL BY OKHOTSK SEA ICE

Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 10 Nov 83) pp 27-31

[Article by Ye.I. Archikov and L.Ye. Stepanova, Far Eastern State University, Vladivostok]

[Abstract] The specifics of capture of fragmentary material by ice on the shores of the Sea of Okhotsk was studied from 1960 through 1983. Analysis

of bottom samples on the 15th cruise of the research vessel "Kallisto" supplemented this information to assist in this attempt to determine the extent of the ice factor in the delivery of fragmentary material to the bottom of the sea far from shore. Eight methods were found for capture of fragmentary material from the shore, the most important of which is freezing of fragments onto the bottom of the ice at low tide. Seven regions of the Sea of Okhotsk are distinguished by different mechanisms of capture of fragmentary material by the ice. Wave abrasion of the shore is directly proportional to the quantity of fragmentary material captured by the ice. Capture of fragments by ice increases abrasion of the shore during the ice-free period. Analysis of the quantity of abrasive material, solid runoff of rivers and quantity of fragments captured by the ice shows that névé ice is significant in the process. The spread of fragments over the water area by ice is comparable to other factors in the formation of bottom sediment. Figures 1; references: 10 Russian.

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UDC 552.124.4(265.4)

#### COMPOSITION AND STRUCTURE OF MANGANESE ENCRUSTATIONS IN SEA OF JAPAN

Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 29 Apr 84) pp 125-128

[Article by L.Ye. Shterenberg, V.A. Aleksandrova, I.F. Gablina, Ye.P. Lelikov, A.V. Sivtsov and M.I. Stepanets, Geology Institute, USSR Academy of Sciences; Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, USSR Academy of Sciences, Moscow; Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Abstract] Initial, brief information is presented concerning the mineral composition of manganese encrustations in the Sea of Japan. The materials used in the study were specimens of manganese or encrustations obtained by dredging during the 36th cruise of the research vessel "Pervenets" at 41°25'N, 134°9'E. The structure of the encrustation is complex. Diffractometric analysis of five specimens was performed, indicating that the mineral composition of the manganese formations changes regularly from the base of the encrustation to its upper portion. The lower, massive dark gray layer is birnessite. Higher, less crystallized todorokite appears, becoming predominant in the upper portion of the encrustation. The specimens also contain vernadite ( $\delta\text{-MnO}_2$ ). The results show a general increase in the quantity of todorokite upward through the cross section of the encrustation, though the distribution of todorokite and birnessite was quite complex. Figures 2; references: 6 Russian.

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METHOD OF SEARCH FOR AN EXPLORATION OF MARINE OIL AND GAS DEPOSITS

Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 13 Feb 85) pp 103-108

[Article by I.I. Khvedchuk, Dalmorneftegazgeofizrazvedka Trust, Yuzhno-Sakhalinsk]

[Abstract] There is a need for a scientifically well-validated model of the geological prospecting process in search for and exploration of marine oil and gas deposits. Such a model must be formulated on the basis of a systems approach. The "system" in this case refers to the set of interrelated and interdependent forms and methods of geological and geophysical research, varying in stages and substages, providing high geological and economic effectiveness in the preparation of prospected reserves of oil, gas condensate and natural gas in accordance with the conditions required for commercial utilization of oil and gas deposits. Using the systems approach, the author has developed an optimal model for the geological prospecting process for marine oil and gas, based on the principles of the completeness of investigation, successive approximations of data, equal representativeness, minimization of labor, material and time expenditures. Three stages are distinguished in the process: geological prediction, search and prospecting. These three stages are divided into a number of substages, which are listed in a large table. The complex of geological and geophysical methods to be applied in the various stages and substages is not described. References: 6 Russian.

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CSO: 1865/324

MAGMATISM AND ATLANTIC THERMAL SPRINGS; SECOND CRUISE OF SCIENTIFIC RESEARCH VESSEL 'AKADEMIK BORIS PETROV'

Moscow VESTNIK AKADEMII NAUK SSR in Russian No 4, Apr 86 pp 123-130

[Article by L.V. Dmitriyev, doctor of geological and mineralogical sciences]

[Abstract] The article reports on new Soviet studies of the magma deposits that form the ocean floor using the scientific research vessel (SRV) built in Finland and commissioned in July 1984 as the "Akademik Boris Petrov." Modern technology makes it possible for this vessel, half the size of others for this purpose in the Soviet scientific fleet, to surpass their scientific capabilities. Its sonar system provides a three-dimensional display of a 4-5 km band of ocean floor, and records it as a topographic map. This cruise sought to study changes in the ocean floor relative to age and position in macrostructures, such as ridges, longitudinal transitional ruptures and deep troughs. Deep ocean basalt layers hidden by accumulated ocean deposits and the ages of various topographic features are discussed. The second goal was to study sources of hot hydrothermal

solutions, the so-called "black smudge-pots" that carry copper, zinc, lead, tin, silver and gold from deep in the mantle to the ocean floor, depositing these valuable minerals as sulfide polymetallic ores. The vessel's course was from Leningrad (on 10 February 1985) to the northern end of the Azores-Biscay elevation, then to South American waters, the Canary Islands and the Mediterranean before ending the voyage at Sevastopol. Studies during the cruise showed that along with Nb/Zr ratios, K/Ti ratios also were indicators of mantle basalt enrichment by volcanic sources, and both these ratios have a direct relationship to the breadth of a given ridge and, therefore, the rate of magma deposition. Five points of active volcanic deposits of minerals were recorded in the Middle Atlantic. Figures 5.

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#### VOLCANISM OF REYKJANES RIDGE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 3, Mar 86 (manuscript received 20 Nov 84) pp 53-61

[Article by A.I. Almukhamedov, M.I. Kuzmin, Yu.A. Bogdanov and I.M. Sborshchikov, Geochemistry Institute, Siberian Department, USSR Academy of Sciences, Irkutsk; Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The article reports on study of the Reykjanes Ridge, at 58°, using modern deep drilling and underwater observation apparatus. In recent years similar procedures had facilitated identification of mid-ocean ridge basalts, low-potassium tholeiites formed by primary magma. The rift valley, typical for slow spreading zones, which forms the southern part of the Reykjanes Ridge, shows 2 cm of morphological change annually. Expeditions of the scientific research vessel "Akademik M. Keldysh" using the submersibles Paxis VII and Paxis XI, studied typical pillow lava deposits consisting of basalts and dolerites, with ages varying from 10,000 in one group to 40,000-100,000 years in another and as much as 1 million years in a third group. Lava thickness was estimated at 400-500, and the deposits consisted chiefly of porphyries, with 1-15% impurities. The level of volcanic activity in the zone studied was regarded to be unusual. The basalts found were "primitive" low-potassium tholeiites with low amounts of large-ion lithophile metals (such as Li, Be, Rb, Sr, Zr, Nb, Ba, Hf and Ta) in comparison with the basalts of other geodynamic environments and other spreading zones. The distribution of rare earth metals showed impoverishment of light lanthanides compared to chondrite, thus further confirming the impoverishment of the mantle substrate. Extensive magma "hot-spots" apparently account for the volcanic activity and hot geothermal energy found in Iceland. Figures 5; references 35: 15 Russian, 20 Western.

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CSO: 1865/326

UDC 551.214.553.065(265.53)

FERROMANGANESE FORMATIONS OF SUBMARINE SLOPES OF KURILE ISLANDS ARC

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 2, Mar-Apr 86 (manuscript received 15 May 85) pp 97-100

[Article by G.M. Gavrilenko and S.V. Khramov, Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences; Oceanology Institute, USSR Academy of Sciences]

[Abstract] Although numerous studies have been devoted to ferromanganese nodules of the Pacific Ocean, few have dealt with their genesis and range in island archipelagos. The present article reports on study of petrological materials gathered from the underwater volcanoes Vavilov, Arkhangelsk and Obruchev in the region of the islands Simushir, Chernyye Bratya and Broutona. The material include angular boulders, chiefly of andesite composition. Other basalts, andesitobasalts, andesitodacites and dacites were also gathered. Crumbling varicolored mineral rocks were typical for the Obruchev volcano, while from the Chirip volcano near Iturup Island wrinkled black Fe-Mn rocks were gathered. In general the chemical composition of the Fe-Mn formations gathered from the Kurile Islands arc varied greatly, but trace elements were rare in them. An interesting ferrophosphorite, shell-like formation were found at the Ushishir volcano near Yankich Island. The underwater hydrothermal genesis of these rock formations is clearly expressed in their structure and composition. The Fe-Mn formations were found only in the southern part of the Kurile Islands arc. Figures 3; references 6: 5 Russian, 1 Western.

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UDC 539.196.3:535.375

RAMAN SPECTRA OF SMALL WATER CLUSTERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 44, No 1, Jan 86 (manuscript received 8 Aug 84) pp 54-59

[Article by M.A. Buldakov, I.I. Matrosov and T.N. Popova]

[Abstract] Water clusters are widely present in nature as vapor and fog, the clusters being formed by the hydrogen bond. When the hydrogen bond is formed, the electron density of the interacting molecule is redistributed and there is a partial transfer of electron density from one molecule to another. This work utilizes a spectral method of investigation of small water clusters, the spontaneous Raman scattering method (Raman spectra). Raman spectra were obtained from water clusters in a gas phase at atmospheric pressure, avoiding any significant influence of the environment on the spectra. This is the first time that Raman spectra have been obtained for

valid oscillations of small water clusters. An attempt is made to explain the observed spectra. The results of the work can be used by specialists working on the theory of the hydrogen bond. Figures 2; references 14: 6 Russian, 8 Western.

6508/13046  
CSO: 1865/193

UDC 551.834(261.866)

GEOLOGICAL STRUCTURE AND DEVELOPMENT OF SIERRA LEONE SUBMARINE RISE (EQUATORIAL ATLANTIC)

Moscow BYULLETEM MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 61, No 3, May-Jun 86 (manuscript received 1 Mar 83) pp 32-37

[Article by V.I. Kara, V.A. Lebedev, S.N. Mitulov and Yu.I. Svistunov, Okeangeofizika Scientific Research and Production Institute of "Yuzhmor-geologiya" Production Association, Gelendzhik]

[Abstract] Within the area of the Sierra Leone Rise, Soviet and foreign researchers have carried out deep drilling and considerable geophysical research, making possible extensive revision of earlier concepts considering this structure. It was found that this rise is broken into blocks by faults of sublatitudinal (associated with equatorial shearing deformations) and northeasterly (younger) strikes. The first of these form grabens filled with a great thickness of sedimentary formations, whereas the second break the Sierra Leone Rise into a series of morphologically different blocks. The largest graben, with a sublatitudinal strike, divides the rise into northern and southern parts which are structurally different. Three main tectonic stages can be distinguished: prevolcanic, volcanic and oceanic. The new mapping of the ancient sedimentary cover within the area of the rise made it possible to ascertain its structural position during different periods. In the pre-Cretaceous it was a part of southwest Africa, with which all structural connections were lost during the period of volcanic activity. From the Late Cretaceous to the Middle Eocene the rise became separated from the continental margin and its northern and southern parts became separated. Beginning with the Late Eocene the surface of the rise differentially but gradually sank below the level of the lysocline and an oceanic sedimentary mantle was formed within its limits. References 5: 2 Russian, 3 Western.

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CSO: 1865/345

CHARACTERISTICS OF SUSPENDED MATTER AND PROCESSES OF MODERN SEDIMENTATION IN  
EASTERN GULF OF FINLAND

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA,  
GEOGRAFIYA in Russian No 1, Mar 86 (manuscript received 20 Jun 85) pp 12-19

[Article by L.K. Barkov, A.V. Budarkov and Ye.M. Shcherbakov]

[Abstract] The characteristics of concentration of suspended sediments in the eastern Gulf of Finland were studied using mean turbidity values over vertical lines, since many measurements of turbidity at three levels showed no regular vertical distribution of the concentration of suspended matter. The composition of the suspended sediments was dominated by fine and medium aleurite fractions. Large particles are transferred primarily by slipping along the bottom. The largest grains are well rounded. The fraction smaller than 0.01 mm tends to clump together. The water mass in this area always contains over 48,000 cubic meters of sediment, which gradually settles to the bottom. During the winter, the water is significantly clarified, even quite deep. The mean vertical concentration of suspended sediments can be established at any point in the water area under any dynamic conditions by means of an equation derived in this article. The distribution of suspended matter over the longitudinal profile of the eastern Gulf of Finland during a strong westerly storm is computed. Figures 3; references: 3 Russian.

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REACTION OF OCEAN TO TYPHOONS MOVING AT VARIOUS SPEEDS (NUMERICAL EXPERIMENTS)

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA,  
GEOGRAFIYA in Russian No 1, Mar 86 (manuscript received 15 May 83) pp 58-71

[Article by R.G. Grigorkina and Yu.A. Chistyakov]

[Abstract] Numerical experiments using a numerical model of the reaction of the ocean to moving tropical cyclones are used to study the influence of changes in the parameters of a typhoon, including its speed of movement, on the reaction of the upper layer of the ocean down to the upper limit of the main thermocline, with the mixed layer assumed deep and well developed when the typhoon arrives. It is found that the variation in reaction of the ocean as a function of speed of movement of the typhoon, which determines the duration of action of the wind at a fixed point as well as the asymmetry of its distribution, influences the water temperature and thickness of the mixed layer as follows: (1) the maximum drop in temperature of the water in the wake of the typhoon increases with decreasing speed of movement; (2) the temperature wake, as well as the zone of decreased thickness of the mixing

layer (upwelling zone) are asymmetrical, asymmetry increasing with increasing speed of movement; (3) the area of maximum temperature drop and area of upwelling are ellipsoidal in shape, the long axis oriented along the trajectory of the typhoon being approximately equal to the distance between typhoon centers; (4) the parameters of inertial oscillations of the boundary of the mixed layer also depend on the speed of the typhoon. The ratio of wavelengths in various experiments is directly proportional to the ratio of speeds of movement of the typhoon and their amplitudes are inversely proportional to it. Figures 5; references 11: 9 Russian, 2 Western.

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UDC 550.4

#### RELATIONSHIP BETWEEN MORPHOLOGY AND CHEMICAL COMPOSITION OF NODULES AND COMPOSITION OF SURROUNDING SEDIMENT

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA in Russian No 1, Mar 86 (manuscript received 8 Oct 85) pp 91-95

[Article by P.I. Piven, P.A. Vaganov, V.A. Meyer, B.G. Vanshteyn, L.I. Anikeyeva and S.I. Andreyev]

[Abstract] The upper and lower layers of sediment and ferromanganese nodules contained in them were studied to establish the relationship between chemical composition of nodules and surrounding sediment. The method of major components of factor analysis was used to establish cause-effect relationships between the composition of nodules and the surrounding sediment. Analysis of the normalized values of chemical element content showed that the following opposite groups are distinguished among the structures of the correlations: the first, represented primarily by rare earth and rare elements, reflects the process of accumulation directly from sea water; the second apparently characterizes edaphogenous components of both sediments and nodules, including Au, As, Sb and Ag. Manganese, copper and nickel have positive correlation coefficients with elements of both groups. Iron has a similar relationship but with negative correlation coefficients with manganese, copper and nickel. The remaining elements have insignificant correlation coefficients and form no clear associations. The major source of iron and manganese is considered to be the sea water. Two stages of accumulation of the chemical elements in the nodules are distinguished: the first corresponds to the syngenetic stage of differentiation of chemical elements in sea water, leading to an increase in the accumulation of rare earth, rare radioactive and metallic elements; the second is related to the stage of differentiation of elements, primarily precipitation of iron oxides and associated elements leading to adsorption of  $Mn^{2+}$  ions and other dissolved ions with subsequent oxidation. Figures 3; references 10: 2 Russian, 8 Western.

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DYNAMICS OF ICE COVER IN WEDDELL SEA DURING 1980

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA in Russian No 1, Mar 86 (manuscript received 5 Jul 84) pp 103-108

[Article by V.V. Golosov]

[Abstract] Photographs taken in 1980 by the "Meteor II" and "Tyros-N" satellites were used to study the dynamics of the ice cover in the Weddell Sea. The following specifics were particularly studied: configuration of the ice edge at various moments in time, general outline and dimensions of the Atlantic ice mass, drift of large icebergs as an indication of movement of water, development of littoral ice fields in the south and dates of beginning of ice formation, development of the barrier field along the Antarctic Peninsula, fracturing of the ice mass, general direction of fractures and dimensions of individual elements of the mass and development of the eastern field, its location, outline and dimensions at various times. Multiannual studies of this type are suggested. Figures 1; references 7: 6 Russian, 1 Western.

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CSO: 1865/328

AVAILABLE POTENTIAL ENERGY IN UPPER LAYER OF WORLD OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 287, No 4, Apr 86 (manuscript received 9 Apr 85) pp 986-989

[Article by V.S. Arsenyev and V.A. Burkov, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Available potential energy (APE), or the difference between the sum of internal and observed potential energy and minimum values for that sum, is a positive and definite quantity related to temperature, pressure and component parts of a liquid, in the present case the alkalinity of the Pacific Ocean. The article presents and discusses possible formulas for determining APE in Pacific waters, taking account of thermal and baric differences as well as temperature stratification in horizontal isentropic surfaces. It includes the entire world ocean system except the north polar region, but only to a depth of 1,500 m, the zone of active surface circulation. Both negative and positive deviations are taken into account. Results showed that in the world ocean from 0-1500 dbar, the PE anomaly amounts to  $99.64 \cdot 10^5$  j/m<sup>2</sup> with dispersion of  $423.53 \cdot 10^5$  J<sup>2</sup>/m<sup>2</sup>. The APE density in the world ocean was nearly double that established by I.L. Vulis and A.S. Monin for the Atlantic alone, due to greater dispersion and greater salinity. The results are regarded as theoretical and approximate. Figures 1; references 8: 3 Russian, 5 Western.

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## MAGNETIC PROPERTIES OF OCEANIC BOREHOLE BASALTS OF WORING PLATEAU

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 27, No 2, Mar-Apr 86 (manuscript received 18 Feb 85) pp 61-68

[Article by I.V. Kashinskaya, K.V. Popov and V.I. Trukhin, Department of Earth Physics]

[Abstract] Pragmatic studies were made of submarine rock specimens from boreholes 338 and 342, drilled during the 38th cruise of the Glomar Challenger in 1974 in the western portion of the Norwegian Sea. The purpose of the study was to establish the peculiarities of the magnetic properties of forward and reverse magnetized vertical sectors in the basalt cores to determine the origin of the forward and reverse natural remanent magnetism in these basalts. Complex isothermal and thermomagnetic studies were used to determine the component composition of the remanent magnetism and the phase composition of the ferromagnetic fraction of the specimens. Parameters determined included  $I_n$ , initial magnetic susceptibility  $\kappa$ , saturation magnetism  $I_s$ , remanent saturation magnetism  $I_{rs}$ , residual coercive force  $H_{cr}$ , magnetic viscosity constants  $S_{VE}$  and  $S_{VO}$ . Comparative analysis of the results of the isothermal and thermomagnetic studies indicated that the 2-component composition of  $I_n$  in the basalts corresponds to the 2-phase composition of the ferromagnetic fraction of the specimens. The positive, anomalous magnetic slope observed in some specimens is produced by the low temperature, low coercivity phase. It is possible that the development of the high temperature daughter phase resulted in the case of positively magnetized specimens in formation in situ of the magnetization vector of the parent low-temperature phase. The interaction between phases causing inversion of  $I_n$  may occur by a magnetostatic mechanism, though this requires further and more detailed study. Figures 4; references 14: 12 Russian, 2 Western.

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## FORMATION OF PERIODIC STRUCTURES UPON LATERAL CONVECTION IN SALT WATER

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 27, No 2, Mar-Apr 86 (manuscript received 1 Feb 85) pp 68-73

[Article by V.M. Blinkov and A.M. Gusev, Department of Physics of the Sea and Continental Waters]

[Abstract] A study is made of the stability of the initial steady flow in stratified salt water filling a rectangular basin of infinite width with a slight deviation from equilibrium state caused by differences in heating of the side walls relative to small neutral disturbances. The data obtained

explain the fact that there are always secondary cells with a second type of circulation in experiments. The formation of the secondary cells usually begins at the horizontal walls of the basin. The boundary conditions placed upon them are therefore one of the factors which influence the form of disturbances which develop. Disturbances arising near each of the horizontal surfaces in the basin must satisfy four conditions for the horizontal and vertical velocity component, temperature and salinity. In all experiments, the bottom and top cover of the basin must be insulated, in contact with the medium, with zero flow. Figures 2; references 11: 6 Russian, 5 Western.

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#### TRANSFER OF OZONE BY MIDDLE ATMOSPHERE CURRENTS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 27, No 2, Mar-Apr 86 (manuscript received 11 Jun 85) pp 75-77

[Article by M.S. Rakova and A.Kh. Khrgian, Department of Atmospheric Physics]

[Abstract] Ozone may be particularly significant as a tracer of vertical movements in the atmosphere. Eleven cases of cold fronts and six cases of warm fronts at the 100-mbar level are analyzed based on the synoptic data of the USSR Weather Center for 1977-1981. Ozone data were taken from 22 ozonometric observatories in Europe, Asia and America. It was found that intensive meridional circulation related to high-altitude cyclones creates characteristic warm, then cold advection in both the troposphere and the stratosphere. In high-altitude anticyclones, the influence of the fronts is not observed, indicating that they are formed in homogeneous warm air, probably tropical, with their characteristic low ozone content. Figures 2; references 5: 4 Russian, 1 Western.

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CSO: 1865/323

UDC 55(261/264)

#### ACHIEVEMENTS OF ATLANTIC OCEAN STUDIES

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 46, No 3, May-Jun 86 (manuscript received 10 Sep 85) pp 120-121

[Article by Ye.F. Shnyukov, Geological Sciences Institute, UkrSSR Academy of Sciences, Kiev]

[Abstract] In recent years there has been strong party and government support for studies of the geological structure and development of the world's oceans

and seas, including mineral raw materials found in them. The article reports on morphostructural analysis of the tectonic mobility of internal oceanic plates and irregularities in ocean bottom development in both space and time. Various authors have prepared geomorphological maps of the Atlantic which show the geological processes that are underway and permit a comprehensive assessment of the ocean floor. Density, sound transmission and reflection, porosity and past conditions help in locating minerals in the ocean floor. The publication "Geological-Geographic Studies of the Atlantic Ocean Floor," by a team of Soviet scientists A.P. Lisitsyn, Ye.M. Yemelyanov and A.V. Ilin, presents the latest in Soviet research in this field. References: 5 Russian.

12131/13046  
CSO: 1865/346

UDC (551.351.2:53)(665.2)

MOISTURE CONTENT OF RECENT BOTTOM SEDIMENTS OF NORTHWESTERN COASTAL SHELF OF GUINEA

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 46, No 3, May-Jun 86 (manuscript received 25 Apr 84) pp 116-120

[Article by V.A. Yemelyanov and N.L.M. Sacco, Geological Sciences Institute, UkrSSR Academy of Sciences, Kiev; Scientific Center, Conakry, Guinea]

[Abstract] Study of aquaphysical and physicomechanical properties of oceanic bottom sediments has shown the importance of moisture content as a determinant of these properties. The article reports on study of bottom sediment moisture (non-constituent water and that outside crystal-hydrates) before and after drying at 105°C. The 60 test samples were collected by a Peterson dredging device in February to October 1983 along the Guinea shelf. Results indicated that the highest moisture content was found in specimens from the Sangarea Bay. Climatic and geomorphological factors are both determinants, as the Dubreka River empties into the bay leaving considerable solid sediments. Moisture content declines as the distance from the river mouth increases and the ocean and the Los Islands (which are only 10-18,000 years old) are approached. Bottom sediment consisting of detrital and shell materials have less moisture content, while higher moisture amounts were found near land areas that had undergone erosion, bringing higher humus in sediments. In general, the northwestern coastal shelf of Guinea had moderate to high moisture-content sediments, chiefly of terrigenous origin.

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STRUCTURE OF MAGNETIC FIELDS INDUCED BY LINEAR INSULATED WIRE IMMERSED IN SEA WATER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 3, May 86 (manuscript received 14 Nov 85) pp 612-614

[Article by A.G. Karpenko, L.A. Lobachevskiy and V.V. Migulin, corresponding member, USSR Academy of Sciences, Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Institute, USSR Academy of Sciences, Troitsk, Moscow Oblast]

[Abstract] Earlier studies have shown that a magnetic field is caused when an electric wire is dipped into sea water, with little relationship noted to the "return electric current" in the water surrounding the wire. The importance of an exponential factor for determining damping of alternating electric and magnetic fields, and neutralization of charges in proximity to the electrodes, are discussed. Calculations showed that as distance from the wire increased, the magnetic field also declined in a quasi-static manner, as  $R^{-2}$ , although the direct current, like indirect current, was four times less than that of the quasi-static field. The difference was caused by the contribution of the "reverse current" flowing through the water between the wire ends, a phenomenon practically unheard of with a low-frequency alternating current. References: 1 Russian.

12131/13046  
CSO: 1865/355

POLYMERS THAT DECREASE HYDRODYNAMIC RESISTANCE AND CERTAIN HYDRODYNAMIC PROBLEMS OF ATHEROSCLEROSIS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 3, May 86 (manuscript received 16 Apr 85) pp 575-577

[Article by M.V. Kameneva and A.S. Parfenov, Mechanics Scientific Research Institute, Moscow State University imeni M.V. Lomonosov; Second Moscow State Medical Institute imeni N.I. Pirogov]

[Abstract] Such common ailments as ischemic heart disease and stroke and atherosclerosis are related to oxygen deficiency. Studies of blood vessel geometry, arterial blood pressure and blood fluidity have provided incomplete answers to the treatment of these ailments. The present study focuses on blood fluidity and hemodynamics in general when certain soluble polymers are introduced into the bloodstream to reduce hydrodynamic resistance. The authors sought to eliminate the reduction in blood pressure caused in some experimental animals when treated for atherosclerosis of brain and heart vessels. A polymer that reduced peripheral resistance made the preparations for hypertension much more effective. One polymer tested was polyethylene

oxide WSR-301 at a concentration of  $10^{-5}$  g/ml. After its administration, blood pressure fell by an average of 20%; blood volume rose by 10% in five cases and remained unchanged in others. Blood fluidity did not change. Some animals were given mezaton, a hypertension preparation. It caused insignificant increases in blood pressure and as much as 20% increased flow through the femoral artery. Thus, administration of both preparations is indicated for treatment of atherosclerotic ailments of the heart, brain and other organs. References 12: 6 Russian, 6 Western.

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UDC 551.465

#### INTERACTION OF SYNOPTIC VORTICES OF FINITE AMPLITUDE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 3, May 86 (manuscript received 31 May 85) pp 585-589

[Article by G.G. Sutyrin and I.G. Yushina, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Synoptic changes in the ocean are known to be determined by cyclonic and anticyclonic wind formations of about 200 km in diameter; modeling of these cyclones has been attempted to assess the beta-effect in major weather disturbances. The article presents an approximation for describing baroclinic movements, to determine the beta-effect of the interaction of two cyclonic or two anticyclonic weather systems. Calculations are presented that relate longitudinal and latitudinal factors, the earth's radius, and zonal and meridional rates of motion. Results indicated that in contrast to anticyclones, cyclones moved to the west more slowly than the most rapid linear "Rossby" waves, since the thickness of moisture layers declined in them. Finite amplitude studies were regarded as useful for determining the evolution and interaction of intensive synoptic oceanic cyclones. References 15: 12 Russian, 3 Western.

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UDC 538.519.26

#### SPATIAL CORRELATION OF SURFACE NOISE IN ACOUSTIC WAVEGUIDE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 1, May 86 (manuscript received 25 Mar 85) pp 223-226

[Article by S.S. Abdullayev, B.A. Niyazov and P.K. Khabibullayev, corresponding member, USSR Academy of Sciences, Nuclear Physics Institute, Uzbek Academy of Sciences, Tashkent]

[Abstract] Until recently computations of the spatial correlation function for acoustic fields generated by dynamic noise in the ocean, such as surface

waves, have been made by numerical methods. An analytical form of the spatial correlation function for surface noise has been obtained only for a model of the ocean describing it as a semi-infinite homogeneous space. Unfortunately, for acoustic fields whose frequency is below 300-400 Hz computations using such a model agree poorly with the observed phenomenon because the influence of sound refraction and its bottom reflections is important for the low frequencies. Accordingly, a new asymptotic method is proposed for computing the spatial correlation function for the acoustic field generated by surface noise in an ocean of finite depth. The method is developed for a model with a homogeneous liquid layer of a stipulated depth over a semi-infinite, almost rigid bottom. Noise sources are assumed to be concentrated in some plane near the ocean surface. The formulas which are derived were used in plotting curves of the dependence of the required correlation coefficient for different frequencies at different ocean depths. Figures 1; references 8: 6 Russian, 2 Western.

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CSO: 1865/353

UDC 551.463.228

#### ACOUSTIC NOISE THEORY FOR RANDOMLY INHOMOGENEOUS OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 1, May 86 (manuscript received 29 May 85) pp 226-229

[Article by O.E. Gulin and V.I. Klyatskin, Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Abstract] Noise generation and propagation in the ocean are usually described by a boundary-value problem for the wave equation. However, when there are regular inhomogeneities in the medium the solution becomes extremely difficult. A statistically inhomogeneous ocean is exceptionally complex to examine within the framework of the boundary-value problem. The immersion method makes it possible to reformulate the boundary-value problem into a problem with initial conditions for the Riccati equation. Having dynamic causality properties, this equation is effective in an analysis of the statistical characteristics of the noise field in a randomly inhomogeneous ocean. The problem is illustrated by an analysis of the case of a disturbance field generated at the surface by noise sources introduced at this surface and with medium stratification taken into account. The field of sources is assumed to be stationary, homogeneous and described by a stipulated spectral density. Formulas are derived for describing the spatial-temporal spectrum of field intensity of acoustic noise in the considered medium, normalized to the spectral density function for the noise sources. References: 5 Russian.

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CSO: 1865/353

POINT EDDIES ON  $\beta$ -PLANE AND SOLITARY ROSSBY WAVES

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 22 Feb 85) pp 165-173

[Article by G.M. Reznik, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A new type of point eddies on a  $\beta$ -plane is described. This type differs from the well-known geostrophic point eddies in that its structure is essentially dependent on its rate of movement. The velocity field in such an eddy attenuates exponentially with increasing distance from the center of the eddy (the attenuation scale is equal to  $\sqrt{U/\beta}$ , with  $U$  being the velocity of movement along latitude). The theoretical and experimental evidence for the existence of such eddies is presented. Particular attention is given to stationary systems of such eddies moving along latitude at a constant velocity. After demonstrating that such systems can be regarded as very simple Rossby solitons, appropriate solutions are obtained for a rotating basin with a parabolic bottom profile. There is a strong relationship between these point eddies and solitary Rossby waves. For example, an eddy pair can be considered a very simple two-dimensional solitary Rossby wave. The case of an individual point eddy of this type is examined in detail, and it is shown that such an eddy can exist only against the background of a "smooth" current. It is postulated that in the observed localized eddies the highly nonlinear radial-symmetric part masks the dipole "engine" which is responsible for eddy movement. References 19: 14 Russian, 5 Western.

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CSO: 1865/351

SINGULAR GEOSTROPHIC EDDIES ON  $\beta$ -PLANE AS MODEL OF SYNOPTIC EDDIES

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 22 Feb 85) pp 174-179

[Article by V.M. Gryankin, Atmospheric Physics Institute, USSR Academy of Sciences, Moscow]

[Abstract] The equation for the evolution of potential vorticity

$$\frac{\partial}{\partial t} \Delta \Psi + [\Psi, \Delta \Psi] + \beta \frac{\partial \Psi}{\partial x} = 0,$$

where  $\Psi(x, y)$  is the current stream function;  $\Delta = \partial^2/\partial x^2 + \partial^2/\partial y^2$ ,  $[f, g] = \partial f/\partial x \partial g/\partial y - \partial f/\partial y \partial g/\partial x$  are Laplacians and Jacobians, respectively; the x-axis is oriented eastward, the y-axis northward, and the earth's sphericity

is taken into account in the  $\beta$ -plane approximation, that is, the Coriolis parameter  $f = f_0 + \beta y$ , is used in describing ocean dynamics of synoptic spatial-temporal scales. In this article it is shown that with  $\beta \neq 0$  this equation has solutions which describe ensembles of singular geostrophic eddies moving along the  $x$ -axis with a constant velocity  $U$  to both the east and west. The structure of the singular geostrophic eddies on the  $\beta$ -plane is considerably reorganized at scales  $r \gtrsim |R|$ , where  $R = (U/\beta)^{1/2}$ . If  $U > 0$  the eddies are screened and the screening radius is dependent on the velocity of the eddies; if  $U < 0$ , the eddies capture Rossby waves and a formation is propagated which can be interpreted as an associated state (ensemble) of eddies and Rossby waves. The solutions obtained can serve as a very simple hydrodynamic model of phenomena of the blocking type existing in the atmosphere and possibly having analogues in the ocean. In the example of ensembles of two, three and an infinite number of eddies a study was made of the conditions for their existence and dynamic characteristics. Figures 2; references 12: 9 Russian, 3 Western.

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UDC 551.465(264)

#### RESEARCH ON MACROSCALE CIRCULATION IN ATLANTIC SECTOR OF ANTARCTIC OCEAN

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 23 Apr 84, after revision 30 Jan 85) pp 180-185

[Article by V.V. Guretskiy, Arctic and Antarctic Scientific Research Institute, Leningrad]

[Abstract] The mean long-term macroscale circulation in the Atlantic sector of the Antarctic Ocean was computed and compared with various kinds of in situ data. The study was based on archival data for 4,064 hydrological stations, more than 75% of the data relating to the period November-April. Mean water densities were computed at each of 24 horizons from the surface to 4,500 m in a grid with intervals of  $1^\circ$  in latitude and  $2^\circ$  in longitude. The computed circulation was compared with observations of the position of frontal zones and the trajectories of buoys and icebergs, revealing a close correlation between fronts and currents. There was a satisfactory consistency of model and observed drift trajectories. The best agreement between computed and observed trajectories with respect to mean velocity was obtained for regions of strong currents (agreement was poorer for trajectories in the neighborhood of the Weddell Sea circulation. The materials illustrated in three figures (integral circulation (stream functions values in Sverdrup); currents at 50-m horizon and position of frontal zones; observed and computed drift trajectories) are discussed in detail. The computations revealed two axes in the system of the Antarctic Circumpolar Current. The vertical relative mean errors in current velocity due to errors in water density attain 30%. Figures 3; references 22: 7 Russian, 15 Western.

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SYNOPTIC VARIABILITY OF WATER TEMPERATURE AND SALINITY IN CANARIES UPWELLING

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 4 May 84) pp 186-190

[Article by V.I. Voytov and V.M. Zhurbas, Oceanology Institute, USSR Academy of Sciences, Moscow]

[Abstract] The spatial variability of thermohaline fields in the sea surface layer in the Canaries upwelling zone was studied on the 37th cruise of the "Akademik Kurchatov" in two areal surveys of ocean surface temperature and salinity. These surveys, along the coast of the Western Sahara between  $21^{\circ}07'$  and  $22^{\circ}20'N$  in a zone 18 miles wide in longitude, took in part of the shelf and part of the continental slope, the area of anticipated most intensive upwelling. The length of each north-south run was about 200 miles. Ocean surface temperature was measured with a towed thermistor and salinity by analysis of samples taken each half hour. It was found that during an upwelling "event" the horizontal variability of T and S had a high negative correlation, but with a meteorological situation unfavorable for upwelling there was a tendency to a change in the sign of T,S correlation to positive. A thermohaline front with a horizontal temperature gradient up to  $0.7^{\circ}\text{C}/\text{km}$  was observed at the boundary of upwelling waters and open ocean waters. The upwelling of waters at the time of upwelling "events" occurred for the most part from the horizons 100-200 m. After an "event" has ended the system has a tendency to return to its natural stable state with a minimum of accessible potential energy in which there are no horizontal density gradients, and the correlation of horizontal variations of temperature and salinity is positive. All these findings show clearly that there is a reaction of the temperature and salinity fields in an upwelling zone to the synoptic variability of meteorological conditions. Figures 4; references 4: 1 Russian, 3 Western.

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TRANSPORT AND MIXING OF OCEAN WATERS IN SYNOPTIC EDDY FIELD ACCORDING TO POLYMODE DATA

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 17 Jan 85, after revision 21 Feb 85) pp 191-198

[Article by N.A. Maksimenko, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The transport and mixing of waters in the open ocean were studied by an analysis of experimental data in the POLYMODE test range collected in the Sargasso Sea during the period July 1977-August 1978. The research was

carried out using stream function values for the synoptic component of the current at the horizons 100, 400, 700 and 1,400 m, computed by the optimum interpolation method using current velocity measurements in a system of 19 buoy stations in a test range centered at 29°N, 70°W. Stream function values were determined at the points of intersection of a grid at 18-km intervals. A 9-point interpolation scheme was used in determining current parameters at different measurement horizons. The error in determining the stream function is  $\pm 1\%$ ; for velocity and relative vorticity the errors are 5 and 30%. Stream function maps revealed eddies with typical dimensions about 100 km. Motion of water in the field of an oceanic cyclonic eddy was investigated by first discriminating the nonstationary core of the eddy, then constructing the trajectories of individual liquid particles and study of the liquid contours, and, finally, solution of the pertinent transfer equation. It is evident that strong mixing in the field of synoptic eddies is a characteristic feature of quasi-two-dimensional geostrophic turbulence. Figures 5; references: 5 Russian.

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#### SPECTRUM OF ENERGY FLUX TO WAVES

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 7 May 84) pp 199-203

[Article by D.V. Chalikov, Leningrad Division, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences]

[Abstract] Numerical modeling of the structure of the turbulent boundary layer over single- and multimode surfaces was undertaken making use of the Reynolds equations in a nonstationary curvilinear coordinate system related to the wave surface. Turbulence was parameterized using the equation for the evolution of kinetic energy of turbulence and the local self-similarity hypothesis. The spectra of energy fluxes to waves were computed and compared for cases when the wave surfaces correspond to the Pierson-Moskovitz, JONSWAP and State Oceanographic Institute spectra. The general laws of spectral distribution of the energy flux density were determined as a function of dimensionless fetch. By a comparison of monochromatic and spectral computations in terms of the spectral growth parameter, it was found that there is a good agreement of data from different numerical experiments, a qualitative agreement with the empirical dependence and the Miles theory. It was then possible to propose an approximation of the growth parameter as a function of dimensionless frequency. A number of suggestions were made for improving the model, such as testing of different schemes for the parameterization of turbulence, study of the influence of low-frequency turbulence and generalization of the model for a three-dimensional case. Figures 2; references 13: 10 Russian, 3 Western.

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SEASONAL VARIABILITY OF THERMAL STRUCTURE OF UPPER OCEAN LAYER IN POLYMODE REGION

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 19 Sep 84, after revision 27 Dec 84) pp 204-211

[Article by I.M. Belkin and B.N. Filyushkin, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A study was made of the seasonal variability of the main characteristics of thermal structure of the upper ocean layer (thickness and temperature of the upper quasi-homogeneous layer (UQL), depth and maximum temperature gradient in the seasonal thermocline, depth and temperature of the lower boundary of the seasonal thermocline). The research was based on 540 soundings with several types of instruments during the period 1977-1978 during the POLYMODE experiment in the region 28-30°N, 69-71°W. Figure 1 shows the seasonal variability of the thickness of the upper quasi-homogeneous layer and its temperature; Fig. 2 illustrates the seasonal variability of depth of the maximum gradient in the jump layer and the value of this gradient; Fig. 3 gives the seasonal variability of depth of the lower boundary of the seasonal thermocline and the temperature there; Fig. 4 represents the seasonal variability of the thickness of the upper quasi-homogeneous layer as determined by different authors. The data represented by these figures are analyzed and discussed. There are striking differences in the thickness of the upper quasi-homogeneous layer reported in the literature. These are in part attributable to the diversity of initial data and differences in the method for discriminating the upper quasi-homogeneous layer. However, it has become increasingly clear that an enormous role is played by year-to-year and synoptic variability of vertical structure. This variability greatly invalidates results obtained by the averaging of data by area and by standard horizons which have been published over a period of years. Figures 4; references 26: 11 Russian, 15 Western.

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FORMS OF PRESENCE OF IRON AND MANGANESE IN WATERS OF PETER THE GREAT BAY (SEA OF JAPAN)

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 20 Feb 84, after revision 23 Apr 84) pp 243-248

[Article by N.N. Bogdanova and V.M. Shulkin, Pacific Ocean Geography Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Abstract] Dissolved and suspended forms of iron and manganese were determined in the surface waters of Peter the Great Bay and their relationship to some

biological parameters was investigated. Samples of water and suspended matter were taken from the horizon 0.1-0.3 m. Samples were taken in July 1979, October 1980 and June-July 1983. Three maxima of production activity occur in the plankton association of this bay. The summer samples were taken during the period of maximum development of phytoplankton or immediately thereafter, whereas the autumn samples were taken during the period of predominance of destruction processes. The samples were filtered through processed and weighed membrane filters for separating dissolved and suspended forms of existence metals. The concentration of metals in the suspended matter was determined after decomposing the filters with a mixture of mineral acids. The iron in these sea waters was detected in the form of lipidlike, inorganic and solid organic forms. In the case of manganese the main form of existence in solution is inorganic. An analysis of the correlations made it possible to evaluate the influence of production-destruction processes on the forms of presence of elements in waters of the open part of the bay. The level of development of the plankton association clearly influences dissolved forms of iron. This dependence is not observed for manganese due to its high mobility during photosynthesis. The concentration of metals in suspended matter is governed primarily by the extent to which the suspended matter is of terrogenous origin. Figures 1; references 17: 13 Russian, 4 Western.

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UDC 535.5

#### APPLICATION OF ELLIPSOMETRY IN STUDYING OIL SLICKS ON SEA SURFACE

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 9 Dec 85) p 252

[Article by K.S. Shifrin, Yu.V. Villevalde and N.P. Petko, Leningrad Division, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences; Leningrad Division, State Oceanographic Institute]

[Abstract] Determination of the optical constants of petroleums and the thickness distribution of oil slicks on the sea is essential for a number of practical reasons. Published data are lacking and no allowance has been made in previous studies for the chemical and biological degradation of such slicks. These effects can be taken into account, however, by taking sea surface samples and using reflective ellipsometry for studying the parameters of interest. Model research was carried out to demonstrate effectiveness of this method for obtaining data on the aging of optical constants of petroleums and slick thicknesses. This involved study of changes in the polarization characteristics of a light beam reflected from the object. Ellipsometry makes possible simultaneous determination of the refractive index, absorption coefficient and film thickness. Research was conducted with petroleums from three deposits and common vehicle oil. Real conditions were simulated using plane oil films on distilled water in Petri dishes. Measurements were with an LEF-2 laser photoelectric ellipsometer using a wavelength  $\lambda = 6328 \text{ \AA}$ . The optical constants of

petroleum products and film thicknesses were obtained for five samples in the range 100-7500 Å. Analysis of data obtained with different angles of ray incidence revealed the feasibility of the method in reliable determination of oil slick thickness. References: 3 Russian.

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UDC 565.324(551.461.6/7)

MASS SPECIES OF OCEANIC HERBIVOROUS COPEPODS IN WORLD OCEAN AND THEIR ECOLOGICAL FEATURES

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 8 Feb 84) pp 288-294

[Article by A.K. Geynrikh, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A generalized study was made of the species composition of mass oceanic copepods in the world ocean and the types of their annual cycles of reproduction and development are described. A full-page map in the text, compiled on the basis of data in the literature, shows the geographical distribution of dominant species. The differences in geographical distribution are analyzed. It is revealed that in addition to species with cycles oriented on temporary resources, in all associations there are those oriented on constant resources. The latter are capable of multiplying year-round or almost year-round, the population at each moment varies in age, generations can greatly overlap, vertical distribution changes less by season than for those relying on temporary resources, they never leave the euphotic zone, they do not accumulate adequate body fat that they could survive long by drawing upon such a reserve and they feed throughout the year. Most of these species are small in size. The quantitative domination of species of copepods with definite types of vital cycles is important for the seasonal cycles of change in the quantity of phytoplankton. Trophic copepods oriented on constant resources dominate over a long part of the year. Due to the peculiarities of their cycles, a stable quantity of phytoplankton is maintained during this time. However, they are no hindrance to phytoplankton bursts which possibly occur due to significant changes in the taxonomic and size composition of algae. Figures 2; references 28: 19 Russian, 9 Western.

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PLANKTON IN LOWER LAYERS OF BLACK SEA OXYGEN ZONE

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 5 May 85) pp 300-309

[Article by M.Ye. Vinogradov, E.A. Shushkina, M.V. Flint and N.I. Tumantseva, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] In the Black Sea there is a sharp difference in the density of deep and surface waters, resulting in stagnation and their hydrogen sulfide contamination. Important aspects of this problem were studied during April-May 1984 on the 6th cruise of the scientific research ship "Vityaz" using 150-liter bathometers, DzhOM 80/113 nets and direct counts of mesoplankton made using samples collected from the submersible "Argus." This made it possible to study the vertical distribution of plankton in the lower layers of the oxygen zone of the Black Sea. The work was done at 17 stations in the eastern and western regions of the abyssal part of the sea mostly on a run from Batumi to Burgas. In the lower part of the oxycline, with an oxygen concentration 1.0-0.5 ml/liter, during the daytime there was a layer of concentration of mesoplankton with a biomass up to 2-3 g/m<sup>3</sup>, sometimes even 30 g/m<sup>3</sup>, with a constant vertical structure. The upper part of this layer is characterized by concentrations of the ctenophores *Pleurobrachia pileus*, whereas at greater depths there is a maximum of the concentration of the copepods *Calanus helgolandicus*, with the lowest part of this layer being occupied by concentrations of *Sagitta setosa* and sexually mature *Pseudocalanus elongatus*. Downward the layer is bounded by the isooxygens 0.5-0.4 ml·O<sub>2</sub>/liter. Still deeper, to the upper boundary of appearance of hydrogen sulfide, there were concentrations of bacteria, with the maximum being in the upper part of the hydrogen sulfide zone, zooflagellates, infusorians and sometimes ciliates. The trophic interrelationships among these plankton groups are discussed. Figures 6; references: 14 Russian.

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PRINCIPLES FOR AUTOMATION OF SIMULATION IN BIOOCEANOLOGY: EVENT APPROACH CONCEPT

Moscow OKEANOLOGIYA in Russian No 2, Mar-Apr 86 (manuscript received 19 Mar 84, after revision 16 May 85) pp 317-324

[Article by M.V. Galperin, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] In the field of ecology it has become increasingly clear that simulation is undergoing a difficult period. There is a wide gap between

theoretical and practical work. There is no unified method for formulating models, resulting in problems in comparing work done by different specialists. Often different mathematical approaches are used even when dealing with similar classes of systems. The mathematical approaches used in economic or engineering simulation are ill-suited in many cases for describing the functioning of biological objects. Moreover, individual specialists are incapable of formulating and solving many problems in ecology. Accordingly, the author has reviewed the fundamental principles of simulation theory with the objective of developing an automated simulation system on such a basis. Examples of the testing of simulation schemes in earlier work in the field of ecology are cited and critically examined. It is demonstrated that the requirement for the standardization of morphological, functional and informational description for the automation of simulation dictates development of a new concept for examination of functioning of marine ecosystems. As a first step in this direction, the author proposes an "event" classification of processes transpiring in such ecosystems. The fundamental parameters of such an approach to the formal representation of functioning of ecosystems are set forth for the purpose of formulating the desired simulation system. A detailed algorithm is outlined as an example of what is possible along these lines. Figures 3; references 13: 11 Russian, 2 Western.

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#### DYNAMIC CHARACTERISTICS OF VDK SENSOR FOR MEASURING VELOCITY

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript received 3 Jan 84, after revision 17 Apr 84) pp 335-341

[Article by S.Yu. Kuznetsov and N.S. Speranskiy, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] An inductance variant of the VDK sensor, a dynamic pressure transducer, has been tested as an alternative method for measuring current velocity. The proposed variant is a differential inductance sensor with a sensing element in the form of a sphere or disk attached to an armature by a support piece. The deflection of the armature, proportional to the moment of forces acting on the sensing element, is transformed into the unbalance current of a bridge circuit and sent to a recorder. The instrument is simple in design, strong and reliable in operation in situ, as well as compact. Its operation is not dependent on the presence of suspended sediments in the water, which are responsible for significant errors of modern acoustic and electromagnetic sensors or make their use impossible. However, it is encumbered by inertia and the fact that the measured parameter is the force of dynamic pressure on the sensing element, not velocity. When determining instantaneous velocity, it is necessary to know the frequency characteristic for the force sensor and have a method for conversion from dynamic pressure to velocity. The required frequency characteristics were computed. The method for

determining instantaneous velocity from the measured dynamic pressure is outlined. Dynamic calibration of the sensor in the velocity range 0.3-1.2 m/s is described. The instrument is particularly useful for conditions typical of the coastal zone. Figures 5; references: 17 Russian.

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RESEARCH IN THE TROPICAL ATLANTIC (TWENTY-NINTH CRUISE OF SCIENTIFIC RESEARCH SHIP 'AKADEMIK VERNADSKIY')

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 pp 343-345

[Article by N.N. Karnaushenko, V.A. Gayskiy and A.B. Polonskiy]

[Abstract] The 29th cruise of the research ship "Akademik Vernadskiy" emphasized research in the Tropical Energy Active Zone in a test range seaward of the mouth of the Amazon. The cruise lasted 145 days (20 July-12 December 1984). The expedition, consisting of 14 scientific detachments, was headed by N.N. Karnaushenko. A total of 25 stations were occupied in the Amazon range with soundings in a first survey to depths of 3,600 m and in a repeated survey to 2,000 m. Investigations centered on heat transfer processes. It was found that during the summer-autumn seasons the Guiana Current turns eastward in two branches in the regions 5°N, 50°W and 8°N, 52°W, merges with the Antilles-Guiana Countercurrent and plays the principal role in forming the Inter-Trades Countercurrent. In the region of turning of the second branch of the Guiana Current there was a quasi-stationary anticyclonic circulation measuring about 100 x 200 miles. Westward of 52-53°W there is no evidence of any strong jet current transporting southern hemisphere waters into the Surinam and Guiana regions. During the summer-autumn of 1984 the position of the ICZ in the Atlantic remained unchanged. The main cloud cover zone was between 5 and 12°N. The ICZ axis was between 6 and 9°N in the eastern part of the Atlantic and between 8 and 10°N in the western part. It was concluded that the mechanism of meridional transport of heat in the equatorial-tropical Atlantic is as follows. From the equator to the southern boundary of the tropical cyclonic circulation the heat is transported in the upper baroclinic layer of the gradient component of the Guiana Current. Then it is redistributed in a zonal direction by the Inter-Trades Countercurrent, from whose northern boundary the heat received from the southern hemisphere and from the atmosphere in the tropical zone is transported northward primarily by drift currents in the upper quasi-homogeneous layer. The maximum meridional drift heat transport is observed at 15°N. Research was also carried out in a test range off the coast of Equatorial Guinea, with the following findings: During the autumn in the central and southwestern parts of the test range, there was dominance of the southerly branch of the Inter-Trades Countercurrent, occupying the layer 0-400 m; the Canaries Current in the test range was weakened; a layer of freshed waters of fluvial origin

was traced for a distance as great as 80-90 miles from the coast; coastal and oceanic zones of upwelling were detected; the winter period of biological productivity was considerably depressed.

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UDC 551.463:910.2

COMPREHENSIVE GEOPHYSICAL RESEARCH ON FOURTH VOYAGE OF SCIENTIFIC RESEARCH SHIP 'RIFT'

Moscow OKEANOLOGIYA in Russian Vol 26, No 2, Mar-Apr 86 pp 346-348

[Article by V.N. Moskalenko, L.G. Akentyev, N.K. Karpenko and I.A. Sheremet]

[Abstract] A joint expedition of the scientific research ships "Rift" and "Vityaz" (expedition chief V.S. Yastrebov) was carried out during the period 25 July-7 October 1984 in the Mediterranean and in the nearby Atlantic. Emphasis was on areas of underwater volcanoes in tectonically active regions. Information was collected on Meso-Cenozoic volcanism and its relationship to the tectonic development of the Mediterranean Sea, the nature of sedimentation and ore formation in volcanic regions. The "Rift" concentrated on a geophysical survey of bottom relief and study of magnetic and gravity fields in test ranges. Continuous seismic profiling was carried out along a series of runs. Work was done in five test ranges [a map accompanies the text]. The complexity of this program required use of a wide array of state-of-the-art instrumentation and apparatus. The total length of the geophysical survey of the magnetic and gravity fields was 3,000 miles; the length of the seismic profiles (common deep point, reflected waves methods) was 500 miles; length of continuous seismic profiling was 155 miles. The results of work in each of the five test ranges (Vercelli seamount in Tyrrhenian Sea; Vavilov volcano in Tyrrhenian Sea; Ampere seamount in Atlantic; Josephine seamount in Atlantic; area to south of the Peloponnesus) are concisely described. For example, it was confirmed that Ampere is situated on one of the sublatitudinal tectonic faults in the earth's crust in the Azores-Gibraltar zone. Crustal structure near Josephine is also determined by the latitudinal Azores-Gibraltar zone of faults. The strong anomalous magnetic field, like for Ampere, is evidence of widespread development of basic and ultrabasic oceanic volcanism. For Vercelli, on the other hand, the magnetic anomaly is relatively small (+100 nT, in comparison with  $\pm 1000-1100$  nT for the Atlantic seamounts). At the other end of the studied areas, to the south of the Peloponnesus, there were no magnetic anomalies at all.

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CSO: 1865/351

METHOD FOR COMPUTING WAVE PRESSURE FORCES OPERATIVE ON SEA DRILL RIG JIG

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 5, May 86 pp 111-115

[Article by S.S. Khvorostovskiy, Moscow Geological Prospecting Institute imeni Sergo Ordzhonikidze]

[Abstract] A tubular jig usually connects the mouth of a marine borehole and the drill rig superstructure. The jig is subjected to many compressive and flexural loads. The admissible depth of explored sea areas is dependent on the design and strength of the rig. Load parameters must be calculated, but this is extremely difficult. Most importantly, it is necessary to determine the resultant of wave pressure on the jig and the coordinates at which it is imparted. The jig is surrounded by an unsteady periodic flow of a fluid of variable direction with a time-variable velocity gradient along the axis of the jig. The pressure force, determined by the velocity head and the acceleration of water particles, is dependent on many factors, such as the size, shape and surface condition of the jig, flow structure and viscosity, formation and detachment of eddies. The article describes an analytical method for computing the parameters of the wave pressure resultant and gives the derivation of formulas for calculating tubular jigs of virtually any design. The initial data used for this purpose included: known experimental expressions for the main characteristics of the resultant of wave pressure on a tubular jig of the simplest design and the dependence between the main parameters of sea waves and changes of these parameters with depth. Five variants of jigs are examined. The proposed method does not require prolonged and costly research for derivation of the required expressions, which will vary depending on specific conditions at the site. Figures 1; references: 3 Russian.

5303/13046  
CSO: 1865/342

FILTERING IN MARINE GRAVIMETRY PROBLEMS

Moscow METROLOGIYA in Russian No 1, 1986 pp 41-49

[Article by V.L. Panteleyev]

[Abstract] A series of proposals is made for solving the problem of dynamic synthesis of an "optimum gravimeter" which would improve the quality of gravimetric measurements made at sea. Emphasis is on dynamic accuracy, whose improvement can be brought about by eliminating, compensating for or lessening the errors introduced by factors of instrumental, methodological or navigational origin. A dynamic error is present if the amplitude-frequency

characteristic is different from unity and the phase-frequency characteristic is different from zero. A key factor involved in obtaining an optimum gravimeter is allowance for the error in filtering gravity from the additive mixture of useful signal and noise caused by vertical movements of the base. Optimum Ag filtering systems are dependent on whether the noise and signal are Gaussian. The high-frequency part of gravity anomalies responsible for the dynamic error has a normal distribution law. An appropriate filtering algorithm is proposed. Two steps are involved. In the first the input signal passes through a dynamic system and a Butterworth filter is used in obtaining the frequency characteristic. In the second the result is passed through the dynamic system in reverse order. Additional procedures for system optimization are proposed. The series of proposals hypothetically should greatly enhance the accuracy of gravimetric measurements at sea. References 10: 9 Russian, 1 Western.

5303/13046  
CSO: 1865/254

UDC 552.124.4:553(265/266)

ROLE OF BIOLOGICAL PRODUCTIVITY OF WATERS IN FORMING NODULAR ORES ON OCEAN FLOOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 2, May 86 (manuscript received 15 Apr 85) pp 462-465

[Article by N.S. Skornyakova, I.O. Murdmaa and V.Ye. Vasilyeva, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The biogenic supply of metals plays a key role in the formation of sediments in pelagic regions, but the authors postulate that in itself this process cannot give rise to the specific composition of ferromanganese nodules in the equatorial zone of enhanced bioproductivity. Another mechanism, also dependent on the degree of development of primary production, is required for ensuring the segregation of Fe and Mn, a necessary condition for the enrichment of the ore matter of nodules with a definite group of sorbed metals. The early diagenetic remobilization of metals, especially Mn, in the surface layer of sediments may be such a mechanism. Increased Mn, Cu, Ni concentrations in nodules in the radiolarian zone (in the case of high Mn/Fe ratios) are characteristic only of a definite type of ore matter with specific structural-textural characteristics and mineral composition. It is surmised that this ore matter is formed due to the precipitation of metals from the ooze waters of sediments in the course of early diagenesis. The geochemical nature of the ore fields in the equatorial zone is determined by the important role played in their composition by nodules in whole or part consisting of such ore matter and belonging to diagenetic and sedimentary-diagenetic types. Economically exploitable nodules can develop only where there are great quantities of settling organic matter, areas of high biological productivity, as in the equatorial zone, where evidence of early diagenetic remobilization of Mn is present. The concept of an ephemeral and mobile nature of the

diagenetically active surface layer of pelagic radiolarian oozes makes it possible to explain a number of ambiguities existing in the genesis of diagenetic nodules. Figures 1; references 15: 7 Russian, 8 Western.

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CSO: 1865/354

UDC 551.465.153

#### SOME DRIFT PATTERNS OF SOFAR FLOATS IN SYNOPTIC EDDY FIELD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 2, May 86 (manuscript received 22 Apr 85) pp 470-473

[Article by V.N. Yeremeyev, L.M. Ivanov and V.I. Smelyanskiy, Marine Hydro-physical Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] A proper description of eddy synoptic processes is possible only within the framework of a multitime energy exchange theory; a single-time approximation does not adequately reflect real conditions in the ocean. Description of evolution of the current-eddy system is possible using three characteristic energy exchange times-- $\tau_{ce}$  (between current and eddies),  $\tau_{ee}$  (between eddies) and  $\tau_{eb}$  (between eddies and background). The relationships between  $\tau_{ce}$ ,  $\tau_{ee}$  and  $\tau_{eb}$  determine the hydrodynamic regimes in this system. These should be manifested in the movement of SOFAR floats, each regime corresponding to its type of trajectory. This relationship is studied in the example of an unstable zonal flow. Lagrangian tracer particles having properties similar to the properties of floats were used in modeling the movement of SOFAR floats. The nonlinear problem for the stability of a stationary zonal flow was solved for a stratified, rotating channel with a plane bottom and a free surface. The flow dynamics was described by the nonlinear equations of a viscous fluid on a  $\tau$ -plane in the Boussinesq and hydrostatics approximation. The model and its algorithm were given in detail in OKEANOLOGIYA, Vol 22, No 6, pp 875-885, 1982. The following cases are examined in detail:  $\tau_{ce} < \tau_{ee}, \tau_{eb}$ ;  $\tau_{ee}, \tau_{eb} < \tau_{ce}$ ;  $\tau_{ee} < \tau_{ce}, \tau_{eb}$ ;  $\tau_{ee}, \tau_{ce}, \tau_{eb} \rightarrow \text{max}$ . The results appear to be applicable to an azonal flow as well. Figures 2; references 12: 6 Russian, 6 Western.

5303/13046  
CSO: 1865/354

SPATIAL-TEMPORAL ANALYSIS OF SEA SURFACE PHOTOIMAGES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript received 4 Apr 84, after revision 12 May 85)  
pp 418-426

[Article by V.M. Burdyugov, S.A. Grodskiy, V.N. Kudryavtsev and A.A. Subbotin,  
Marine Hydrophysical Institute, Ukrainian Academy of Sciences; Southern Seas  
Biology Institute, Ukrainian Academy of Sciences]

[Abstract] A spatial-temporal analysis of sea surface brightness variations is presented and the results of this analysis are compared with the computed parameters of internal gravity waves. The study was based on a series of photographs of the Black Sea surface taken in August 1982 10 miles from the southern shore of the Crimea. The survey was made from an altitude of about 1.5 km with an AFA-42/20 aerial camera with an interval of about 6 minutes. Spatial referencing of the photoimages was accomplished relative to a spot of rhodamine dye released from a support ship. The vertical density structure in this region was characterized by a well-developed seasonal thermocline with a core at ~25-30 m and a temperature drop ~16°C. At the sea surface there were slick bands which were registered clearly from the aircraft laboratory. The dye spot made it possible to determine the displacement of the slick bands relative to the spot, making it possible to evaluate both the spatial structure and the kinematics of variations of sea surface brightness. The proposed successive images method broadens the possibilities for remote study of internal waves, as well as evaluation of the dispersion relation, one of the most important characteristics of the wave process. The reliability in determining the dispersion relation is dependent primarily on the spatial referencing of images. The quality of evaluations can be improved by optimum choice of the survey method. This image analysis method can be used also in evaluating the spatial-temporal parameters of dynamic processes with other spatial scales. Figures 4; references 16: 9 Russian, 7 Western.

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CSO: 1865/338

EXPERIMENTAL RESEARCH ON THREE- AND FOUR-WAVE RESONANT INTERACTIONS OF SURFACE SEA WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript submitted 27 Jun 84, after revision 2 Nov 84)  
pp 412-417

[Article by I.I. Strizhkin and V.I. Raletnev, Moscow Institute of Geodetic,  
Aerial Mapping and Cartographic Engineers]

[Abstract] Research was carried out on three- and four-wave resonant interactions of surface sea waves for the wave length range  $\lambda = 1.0 \text{ cm}-2.0 \text{ m}$  using

photoimages of the sea surface. The photographic survey was made from a platform in the Caspian Sea by two AFA-41/7.5 aerial cameras from a height of 12 m at a scale of 1:160; sea depth in the survey region was 40 m. It was found that there were three-wave resonant interactions in the region of capillary and short capillary-gravity waves and four-wave resonant interactions in the region of long capillary-gravity waves and short gravity waves in the open sea. Three-wave interactions were observed when there were wind velocities 2.7-18 m/s in the wave length ranges 1.0-5.0 cm. In the case of three-wave interactions the discrepancy in the resonance condition for wave numbers does not exceed 2%, and for frequencies does not exceed 22%. Four-wave interactions were discovered for wind velocities 4-6 m/s and waves with lengths greater than 15-20 cm. Data from synchronous analysis of series of photographs and surface registry of waves with a string wave recorder revealed a discrepancy in the resonance condition for wave numbers not exceeding 12% and for frequencies 4%. In the wave length region 5-15 cm the nature of the interaction in neither case can be obtained without experimental data on the dynamics of low-frequency (gravity) waves. The discrepancy of resonance conditions decreases for both frequencies and wave numbers decrease when really existing gravity waves are taken into account. References 9: 6 Russian, 3 Western.

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CSO: 1865/338

UDC 551.466.63

#### LONG ESSENTIALLY NONLINEAR WAVES IN ROTATING OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript received 19 Apr 84) pp 395-405

[Article by V.I. Shrira, Oceanology Institute, USSR Academy of Sciences]

[Abstract] The generalized Boussinesq equation was used in study of long surface and essentially nonlinear stationary waves in a layer of rotating fluid. Explicit analytical expressions (in the hydrostatics approximation) were derived for waves of limiting configuration and the region of the applicability was defined: long surface waves of the tsunami type and long internal waves in the ocean. Since the finding of extremal parameters of waves is highly important for tsunamis, a significant finding was that in a considerable part of the range of scales characteristic for tsunamis the low-frequency dispersion caused by the earth's rotation is dominant and it is possible to use solutions obtained in the hydrostatics approximation. The limits of their suitability were found as a function of wave lengths and amplitudes. Allowance for the influence of high-frequency dispersion can only insignificantly change the limiting wave energy values. This class of waves qualitatively differs from long stationary waves of a lesser scale, for which the main role is played by high-frequency dispersion. A dependence of the parameters of nonlinear stationary waves on medium parameters was found. Estimates were made using the Garret-Munk stratification model. In

this model low-frequency dispersion dominates over high-frequency dispersion in the entire range of long waves. Internal waves are considerably steeper and more nonlinear than surface waves. The limiting density spectrum of internal waves, whose existence is attributable to waves attaining a limiting amplitude, was also determined. Figures 2; references 10: 4 Russian, 6 Western.

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UDC 551.465.41

DEVELOPMENT OF REGION OF PARTIALLY MIXED FLUID IN FINE-STRUCTURED STRATIFIED MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript received 1 Aug 84, after revision 29 Oct 84)  
pp 389-394

[Article by V.A. Popov, All-Union Physicotechnical and Electronic Measurements Scientific Research Institute]

[Abstract] The dynamics of development of a cylindrical spot of partially mixed fluid in a finely structured stratified medium was studied. The experiments were carried out in a basin measuring 40 x 15 x 30 cm; turbulence was generated using a 6-blade vane 1.5 cm in diameter and 15 cm long whose axis was horizontal the width of the basin. To-and-fro circular movements were made with a frequency 15 Hz. Motion and still photographs of the generated current were obtained with a shadow instrument. The experiments were with a stratified fluid, an aqueous solution of common salt with a variable depth concentration. The main feature of development of spots of partially mixed fluid was spot outflow in a horizontal direction in the form of narrow tongues along interlayers with an increased vertical density gradient. The horizontal component of velocity propagation is determined by the degree of expression of fine structure and is greater than the velocity of spreading of spots in a linearly stratified fluid (in this experiment  $\ell_x = K(t/T_0)^n$ ,  $n = 0.7-0.8$ ,  $\ell_x$  is the horizontal dimension,  $T_0$  is the buoyancy period). In all stages of propagation the total volume of the mixed fluid remains constant, being determined by the initially introduced turbulent energy, and the increased spot growth in a horizontal direction is compensated by erosion of the spot boundaries in zones with a reduced density gradient. Figures 3; references 13: 10 Russian, 3 Western.

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CSO: 1865/338

DISSIPATION OF TURBULENT ENERGY IN LAYER OF OCEAN WIND WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript received 12 Jul 84, after revision 20 Dec 84)  
pp 380-388

[Article by A.V. Solovyev, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] The vertical distribution of the rate of dissipation of turbulent energy in the layer of wind waves in the ocean was studied from measurements made in the near-surface layer of the Atlantic Ocean on the 35th cruise of the "Akademik Kurchatov" using a surfacing probe-turbulence meter. The rate of probe movement in a free surfacing regime was 2.2 m/s. Conductivity and the vertical component of velocity fluctuations in the 10-m surface layer of the ocean were measured. The velocity sensor used was a velocity transducer of the magnetohydrodynamic type. The principal sources of errors and methods for reducing their influence on measurement accuracy are tabulated and discussed. A spectral analysis of records of velocity fluctuations revealed existence of a sector corresponding to the spectrum of locally isotropic turbulence. The vertical distribution and rate of dissipation of turbulent energy, computed on the basis of experimental data, indicated its sharp increase in the upper 2-m layer of the ocean. This made it possible to evaluate the influx of turbulent energy from the atmosphere to the ocean. The vertical distribution of the rate of dissipation of turbulent energy in the wind wave layer can be described using the A.Yu. Benilov model (IZV. AN SSR: FAO, Vol 9, No 3, pp 293-303, 1973).

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CSO: 1865/338

QUASI-HOMOGENEOUS MODEL OF EVOLUTION OF TURBULENT WAKE REGION BEHIND BODY IN STRATIFIED MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 4, Apr 86 (manuscript received 10 Apr 84) pp 373-379

[Article by L.I. Skurin, Leningrad State University]

[Abstract] A study was made of the evolution (in the ocean or atmosphere) of the turbulent wake region behind an axisymmetric body for large initial Froude number values. An approximate theoretical study of the region was made for arbitrary times. A model is presented which makes use of the relations derived by G.I. Barenblatt (IZV. AN SSSR: FAO, Vol 14, No 2, pp 195-206, 1978) for the rate of expansion of a spot of mixed fluid in the initial, main and viscous stages of evolution and with additional assumptions concerning an

increase in the volume of this region as a result of turbulent diffusion. Formulas are derived for a quantitative description of the time dependence of the extent of plane turbulent spots in a stratified medium for large initial values of the fluctuating Froude number, under conditions when the increase in volume of the region due to turbulent diffusion is substantial. Then a system of equations is formulated which in a quasi-homogeneous approximation describes the evolution of such spots. The conditions under which the viscous stage of evolution is realized are stipulated. This provided a basis for analysis of evolution of the turbulent wake region behind a hypersonic object in the atmosphere. Figures 3; references 13: 9 Russian, 4 Western.

5303/13046  
CSO: 1865/338

TERRESTRIAL GEOPHYSICS

UNDERGROUND WATER CAN BE SEEN

Moscow DOMESTIC SERVICE in Russian 0450 gmt 24 Apr 86

[Text] Moscow, 24 April (TASS): One can see water through the earth with the aid of the "Gidroskop" unit, constructed by scientists from the Siberian Department of the USSR Academy of Sciences. It makes it possible to dispense with drilling numerous boreholes. The unit "senses" water, even if it is at a depth of 150 meters.

Specialists hope to be able to use the "Gidroskop" at construction sites, during mineral prospecting, in deserts and semideserts when choosing well sites.

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CSO: 1865/273-E

FOSSIL FINDS BY SIBERIAN PALEONTOLOGISTS ADD TO UNDERSTANDING OF LIFE DEVELOPMENT CHRONOLOGY

Moscow TASS in English 6 May 86

[Text] Novosibirsk May 6 TASS--Fossil greenish shells the size of the needle's eye have enabled Siberian scientists to specify chronology of an important stage in the development of the animal world on earth. They were discovered in cliffs on a bank of the Khorbusuonka River in the Yakut tundra (northeastern part of the USSR). The credit for discovering the earth's most ancient skeleton fauna goes to young researcher Galina Karlova of the Geology and Geophysics Institute of the Siberian Department of the USSR Academy of Sciences.

"Today we know that animals developed their skeleton in more ancient times than it was considered before the discovery. It is also possible to claim that the skeleton fauna emerged and became dominant not all of a sudden but in the process of a long evolutionary development," Vsevolod Khomentovsky, doctor of geology, comments on the find.

This position, he holds, provides a new approach to numerous hypotheses which were used to perceive natural mechanisms contributing to the formation of the skeleton in living beings.

The discovery of the earth's most ancient skeleton fauna in Yakutia, in Vsevolod Khomentovsky's opinion, provides a chance for a more exact determination of the main stages in the earth's development, which is of great importance for understanding evolution of our planet and organisms inhabiting it.

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CSO: 1865/273-E

NEW MINERAL FOUND IN USSR

Moscow TASS in Russian 1040 gmt 4 Jun 86

[Text] Moscow, 4 Jun (TASS). A new mineral - "paranatrolite" [phon] has been found on the Kola Peninsula in the USSR. It has been obtained from underground workings in the Khibinyy Mountains.

The mineral was for the first time discovered in 1980 in Canadian reservoirs, but when exposed to the air the mineral quickly disintegrated and study of it was not successful. The Khibinyy paranatrolite turned out to be resistant to atmospheric influence. The scientists obtained an x-ray photograph of it and examined its chemical composition. The mineral can be processed well with water. It consists of sodium and potassium, which can be washed out easily. It is colorless, sometimes a bluish shade. The find has been reported in the journal DOKLADY AKADEMII NAUK SSSR.

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CSO: 1865/281-E

FORUM PARTICIPANTS COMMENT ON U.S. SEISMOLOGISTS AT SEMIPALATINSK

Moscow SOVETSKAYA ROSSIYA in Russian 15 Jul 86 p 1

[Article by A. Belikov and N. Zhelezov]

[Excerpt] On 14 July journalists met with Soviet and foreign scientists taking part in the international forum for halting nuclear tests, at the press center of the USSR Ministry of Foreign Affairs. And although the main topic was the significance of this forum for the struggle which scientists of the world are waging to overcome the nuclear danger, the name of the Soviet city of Semipalatinsk was often mentioned at the press conference. A joint group of seismologists of the USSR and the USA has begun work here. This group has set the goal of demonstrating that total verification that nuclear tests are not being conducted is technically feasible. The first practical step has been taken toward eliminating obstacles to an agreement on halting tests of nuclear weapons.

Academician Ye.P. Velikhov, chairman of the Committee of Soviet Scientists for Peace and Against the Nuclear Danger, stated that the way to concluding an agreement on a universal nuclear test ban has thus been opened from the technical standpoint. He said that participants in the forum produced convincing evidence that no qualitative improvement of nuclear weapons can now improve the strategic situation in the world. There is only one solution: all of the nuclear powers--primarily the USA, but also Great Britain, France and China--must be called upon immediately to join the Soviet moratorium and discontinue all nuclear tests. "We shall request a meeting with the president, but I don't know if he will meet with us..."

Many questions pertained to details of the joint work of USSR and U.S. seismologists at Soviet and American test grounds. T. Cochran (USA), a participant in the mixed group who had just returned from Semipalatinsk, said that the group intends to conduct studies for a year in line with an agreement. It is quite possible that this period will be extended and the program expanded. "We began our work at Semipalatinsk, but we hope to see Soviet specialists in Nevada by November," he said. "But I can now show you an initial result--a seismogram from the vicinity of Semipalatinsk."

Explaining the importance of an agreement concluded between the USSR Academy of Sciences and the U.S. Committee for Protection of Natural Resources,

Professor A. Dewind, chairman of this committee, noted that the question of the possibility of monitoring of tests came to the forefront with the introduction of the Soviet moratorium in August of last year. The agreement between scientists of our countries demonstrates the verification of the observance of a universal nuclear test ban treaty can be ensured without difficulty.

Journalists asked the American scientists: "Today you presented a declaration and met with M.S. Gorbachev, but will such a meeting take place with Mr Reagan, and how sure are you that he will take your appeal into consideration?"

"I don't know," replied Professor F. Von Hippel of Princeton University.

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CSO: 1865/358

## KOLA SUPERDEEP BOREHOLE DESCRIBED

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 86 pp 5-12

[Article by Ye.A. Kozlovskiy, professor, USSR Minister of Geology]

[Abstract] By late 1985 the Kola superdeep hole had reached a depth greater than 12 km. This hole is being drilled in the Pechenga copper-nickel ore region of the Baltic shield, consisting of very ancient Archean and Proterozoic crystalline rocks. The objective of the work is to ascertain the mineralogical composition and physical properties of rocks at great depths, form ideas concerning the geological nature of seismic boundaries in the crust and collect data on heat flows and deep aqueous solutions and gases. It will be possible to solve fundamental geological problems, formulate a new model of the earth's structure and improve prediction of mineral deposits. It has already been possible to construct a section which takes in Proterozoic and Archean complexes dating back to 3 to 1.6 billion years. The first reliable vertical geological-geochemical section of the Precambrian earth's crust has been obtained. It was found that within the ancient crystalline rocks there are underground waters and gases at virtually all the horizons reached by drilling. The entire penetrated interval is saturated with minerals. The different types of mineralization observed are attributable to a succession of sedimentary, magmatic, metamorphic and hydrothermal processes. The electromagnetic, acoustic and radiation fields were studied in relation to mineralogical composition, structure and thermodynamic state of rocks. For the first time in the history of drilling there was intersection of the boundary of sharp change in velocities of seismic waves, but no basalt layer was discovered; the mean composition of the rocks below the velocity jump was approximately the same as above the boundary. The change in velocity can be attributed to decrease in density. It has been postulated that at a depth of 10 km temperature would not exceed 100°C, but in fact it was 180°C. Once considered "dead," it was found that the deep layers are characterized by active biological processes. It has become clear that the nature of rock deformation varies as a function of the geothermal regime in the deep layers. Equally important, many new methods and types of drilling apparatus have been developed in the course of the work. Figures 5.

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CSO: 1865/250

THEORETICAL SEISMOGRAMS OF SURFACE SEISMIC WAVES IN ANISOTROPIC MEDIA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 286, No 3, 1986 (manuscript received 20 Sep 85) pp 592-597

[Article by Ye.M. Chesnokov and S.S. Abaseyev, Earth Physics Institute, USSR Academy of Sciences imeni O.Yu. Shmidt, Moscow]

[Abstract] It is essential to construct theoretical seismograms (especially for surface waves) because they make possible a direct comparison with the experimental seismogram. This would make possible the drawing of more precise conclusions concerning the structure and composition of the earth's deep layers and the processes transpiring there. Accordingly, an attempt was made at constructing theoretical seismograms of Rayleigh and Love waves from a point source in a multilayer anisotropic medium, with the type of symmetry in each layer being arbitrary. The computation scheme is described in detail. On this basis an algorithm was formulated for computing such theoretical seismograms. This is illustrated in the example of transversely isotropic media (the type of symmetry most frequently observed in geophysics). Specifically, examples are given of theoretical seismograms of the fundamental tone of Love and Rayleigh waves for the case of an isotropic layer in a transversely isotropic half-space with the axis of symmetry rotating in the horizontal plane. The source was in the form of a horizontal force (Love wave or a vertical force (Rayleigh wave). In this way it was possible to study the influence of anisotropy on the nature of behavior of theoretical seismograms. Figures 3; references 5: 3 Russian, 2 Western.

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CSO: 1865/246

USE OF SEISMIC NOISE IN STUDY OF LITHOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 286, No 3, 1986 (manuscript received 10 Dec 84) pp 586-591

[Article by A.V. Nikolayev, P.A. Troitskiy and I.Ya. Chebotareva, Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences, Moscow]

[Abstract] Endogenous sources of microseismic oscillations should be manifested most strongly in parts of the medium having local structural defects, such as inclusions, tectonic dislocations and active chemical inclusions, regions with a high concentration of fissures and therefore anomalous background stresses. The microseismic oscillations registered at the surface over such anomalous regions are characterized by an emission component which can be used in pinpointing such regions. The first experience in such research is described. Previous work in this direction had revealed a

complex spatial structure of the registered wave field which cannot be fully explained within the framework of existing models of upper mantle structure. Using the holographic method, in the depth range 50-200 km, it was possible to discriminate regions elongated downward having increased scattering properties, indicating a strong anomaly of properties in the upper mantle. A study was made of two types of seismic noise data: 1) noise generated by the P-coda signal from teleseismic events on Honshu and in the Hindukush and two samples of microseismic noise. Computations were made for depths of 0, 10, 18 and 36 km and then to a depth of 196 km with a 16-km interval; a two-layer model of the medium was used. A hypothesis was formulated for explaining the existence of regions in the upper mantle emitting such microseismic oscillations. It postulates that these regions may be associated either with seismic foci themselves or deep intrusions forming during a period of tectonic and magmatic activity in the region. The analysis revealed that in the upper mantle in the studied region there are sources of microseismic emission whose spatial distribution reflects the stressed state and seismic activity of the lithosphere. Figures 4; references 12: 7 Russian, 5 Western.

5303/13046  
CSO: 1865/246

UDC 550.311:551.211

#### ENTRAINMENT OF SEDIMENTS TO GREAT DEPTHS UNDER CONTINENTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 286, No 3, 1986 (manuscript received 25 Sep 84) pp 583-586

[Article by A.S. Monin, corresponding member, USSR Academy of Sciences, and O.G. Sorokhtin, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The theory of lubrication of the working parts of mechanisms can be used in describing the entrainment of the layer of pelagic sediments covering oceanic lithospheric plates in the subduction zone beneath island arcs or active continental margins. This approach was used by O.G. Sorokhtin, et al., in IZV. AN SSSR: FIZIKA ZEMLI, No 5, pp 3-10, 1976, in which movement within the sedimentary layer between the upper (continental) plate and the lower (oceanic) plate slipping downward along it was described as a stationary laminar Couette flow of a viscous fluid. Proceeding along these lines, it has now been demonstrated that upon entering the subduction zone the sediments are heated primarily due to the viscous dissipation of kinetic energy; the rate of this specific heat release can be computed. There is evidence that light recent sediments cannot be drawn into subduction zones deeper than 30-50 km. In order for oceanic sediments to be entrained to greater depths (such as 200-250 km) they must be heavy in order for their mean density to exceed the mean density of the continental lithosphere. This problem was examined with particular attention because such heavy sediments, even after partial melting, could be drawn along subduction zones to greater depths in the earth's mantle. Specifically, it was found that heavy iron ore

sediments of the Early Proterozoic could plunge to rather great depths along the subduction zones without melting. Figures 1; references: 9 Russian.

5303/13046  
CSO: 1865/246

UDC 551.242.2(261/264)

#### SOME FEATURES OF STRUCTURE OF OCEANIC CRUST IN EXAMPLE OF BRAZILIAN BASIN

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 86 (manuscript received 11 Jan 85)  
pp 46-55

[Article by V.G. Kazmin, O.V. Levchenko, L.R. Merklin, Yu.P. Neprochnov and V.V. Sedov, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences]

[Abstract] A geological and geophysical survey was made in the northern part of the Brazilian Basin during the 31st cruise of the scientific research ship "Dmitriy Mendeleyev." The collected materials suggest that the basement of the basin consists of sloping oceanic crust blocks which have experienced considerable rotation. Slippage of the blocks along the gentle surfaces of faults at the time of rotation in some cases has caused outcrops of third-layer rocks at the bottom surface. Certain nonuniformities of the crust appear to be attributable to the fact that seismic profiles intersected packets of gently sloping layered blocks separated by flattened faults rather than the horizontally layered crust. The Mohorovicic discontinuity is possibly a subhorizontal fracture surface along which flattening-out of the faults occurs, which accounts for its sharpness. The block structure of the oceanic crust in this region is similar to crustal structures in continental rift zones and passive margins forming during dilatation and thinning of the lithosphere and the formation of such a structure is probably associated with dilatation in a mid-oceanic ridge. Figures 6; references 19: 8 Russian, 11 Western.

5303/13046  
CSO: 1865/316

UDC 551.242.2(265/266)

#### STAGES IN TECTONIC TRANSFORMATIONS IN NORTHWESTERN PACIFIC OCEAN AND ITS CONTINENTAL MARGIN

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 86 (manuscript received 3 Nov 84)  
pp 35-45

[Article by Ye.N. Melankholina, Geology Institute, USSR Academy of Sciences]

[Abstract] Crustal restructurings associated with a radical change in the structural plan of the Northwestern Pacific and eastward movement of the

continent-ocean boundary are analyzed (these changes occurred 100-110 and 25-30 million years ago). There is a correspondence of these restructurings in time and an agreement in the field of stresses in the ocean and on the continental margin. These features and comparison of data on paleolatitudes of Pacific Ocean and Asiatic structures clearly indicate that their relative movements were quite limited. Within the Pacific Ocean plate there is evidence of considerable dislocations and stratification of the lithosphere. A series of tectonic transformations at the boundary between the ocean and the continent is outlined for each of the stages. These restructurings are clearly associated with change in position of the boundaries of lithospheric plates. The accumulated data indicate that there is a considerable non-uniformity of oceanic structures and that these had a complex history of development, contradicting the former idea that the Pacific Ocean plate is a unified rigid monolith. A series of conclusions was drawn which requires further confirmation; if confirmed, this would necessitate revision of certain principles in the theory of the tectonics of plates. Figures 4; references 41: 25 Russian, 16 Western.

5303/13046  
CSO: 1865/316

UDC 553.981/982+551.242.2

#### TECTONIC CONDITIONS FAVORING PRESENCE OF PETROLEUM AND GAS IN SEDIMENTARY BASINS OF MARGINAL ZONES OF CONTINENTS

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 86 (manuscript received 28 May 84)  
pp 21-34

[Article by Yu.K. Burlin, N.A. Krylov and L.I. Lebedev, Moscow State University imeni M.V. Lomonosov; Geology and Exploitation of Fossil Fuels Institute]

[Abstract] The tectonic factor is one of the most important factors controlling the distribution of petroleum and gas accumulations under the ocean floor. However, there are distinct differences in the occurrence of petroleum and gas basins in Atlantic (passive) and Pacific (active) types of underwater margin. In passive margins the presence of petroleum and gas is related to the lower structural (riftogenic) complex and within the limits of the latter is associated with a terrigenous polyfacies formation. With saturation of the upper structural complex with hydrocarbons an important role in petroleum-bearing deposits is played by rocks of delta origin. The petroleum and gas deposits are associated largely with longitudinal and transverse grabens. Stratigraphically, the main petroleum deposits are associated with Jurassic-Cretaceous and Miocene sediments. On the other hand, on passive margins the main petroleum and gas reserves are associated with basins in sectors of a formed continental crust. In the petroleum- and gas-bearing deposits the main role is played by delta complexes, whereas in zones of strong tectonic differentiation the key role is played by linearly

elongated bodies of sediments formed by high-velocity flows on steep slopes. Stratigraphically, the main productive horizons are associated with the Miocene and Pliocene. The passive margins possibly are characterized by a greater absolute volume of hydrocarbons. In particular, reef zones and deltas in large grabens are favorable. Figures 6; references 20: 12 Russian, 8 Western.

5303/13046  
CSO: 1865/316

UDC 551.24(5):550.341.5

#### SEISMOGEOLGY, GEOPHYSICAL FIELDS OF MONGOLIAN-OKHOTSK SEISMIC ZONE AND PROBLEMS IN EARTHQUAKE PREDICTION

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 86 (manuscript received 17 Apr 85) pp 26-33

[Article by V.P. Solonenko, Earth's Crust Institute, Siberian Department, USSR Academy of Sciences, Irkutsk]

[Abstract] Materials are presented which demonstrate the inapplicability of the plate tectonics concept for explaining the dislocation of seismogenic structures in the northeastern part of Asia, including the Mongolian-Baykal rift system. This conclusion is drawn on the basis of the enormous volume of geological, geophysical and seismological research carried out during the last 15-20 years. There is no sound evidence that external dynamic forces play any role in the character of the field of stresses in the Mongolian-Okhotsk seismic zone. Instead, these stresses are generated within the region itself and must be related to presently unknown geodynamic processes in the upper mantle and crust. These processes are evidently different in different parts of the seismic zone with respect to morphostructures, history of development, nature of fields of tectonic stresses, focal processes and deep structure. A review of all published data reveals that there is no definite relationship between seismic zones and deep structure. However, there is a dependence of seismic activity on types of morphostructures. This makes it possible with a certain reliability to predict the place, intensity, and to a certain degree, the frequency of recurrence of earthquakes. Figures 1; references 46: 36 Russian, 10 Western.

5303/13046  
CSO: 1865/253

UDC 551.243.35(477.5)

FEATURES OF DISTRIBUTION OF SALT STRUCTURES IN DNEPR-DONETS DEPRESSION

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 46, No 1, Jan-Feb 86 (manuscript received 23 Jul 84) pp 125-132

[Article by N.I. Galabuda and B.I. Malyuk, Fuels Geology and Geochemistry Institute, Ukrainian Academy of Sciences, Lvov]

[Abstract] New data have been obtained on the distribution of salt domes over the area of the Dnepr-Donets depression, where salt tectogenesis is widespread. New patterns and details have become apparent which earlier had been overlooked. Among these discoveries is the observation that salt domes are arranged in a sort of annular framing in marginal zones of the depression in the western part of the region and there is a polygonal-symmetric distribution of salt domes in the southeastern part of the depression. It is emphasized that these discoveries are additional to the quite validly observed patterns described for these same areas, only making them more detailed. Newly collected data have also provided a much clearer idea concerning concentrations of maximum salt accumulation in the downwarps forming in zones adjacent to deep faults in the basement. A comparison of sectors of salt dome development and diagrams of basement faults revealed that the submeridional orientation of salt domes correlates well with the system of submeridional basement faults. New concepts were developed on the formation of salt dome structures. Both the formation and distribution of these structures are closely linked to elements of the internal structure of the basement and the dynamics of their destruction in the course of basin development. The findings suggest that further search for deposits of petroleum hydrocarbons should emphasize the marginal and centroclinal parts of most local depressions in the basin in the marginal and axial zones. Figures 3; references 32: 31 Russian, 1 Western.

5303/13046  
CSO: 1865/235

UDC 552.52.551.263.037.622.24/479.24

ARGILLACEOUS MINERALS OF VOLCANOGENIC ROCKS IN SAATLY SUPERDEEP HOLE SG-1

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 1, Jan-Feb 86 pp 24-31

[Article by A.G. Seidov and M.B. Kheirov]

[Abstract] A detailed study of the pelitic mass of volcanites (first segregated in an ultrasonic disperser) was made of the volcanogenic rocks in the Saatly superdeep hole SG-1 (sverkhglubokaya skvazhina-1). The structural characteristics of these minerals were determined and their distribution in the cross section penetrated by the hole was established. The clayey minerals

described were investigated by x-ray diffractometry, electron microscopy and thermographic analysis. The following minerals were found (and are thoroughly described): hydromica, kaolinite, chlorite, montmorillonite, zeolite and talc. The penetrated layers were also characterized by so-called mixed-layer formations with random alternation of layers of montmorillonite and chlorite, montmorillonite and hydromica, chlorite and hydromica; quartz, calcite, cristobalite and felspars were also present and their composition and position in relation to other minerals were also considered. The argillaceous minerals described developed in the cross section due to the weathering of volcanites under the influence of hydrothermal waters and other fluids. Greenstone metamorphism was a post-volcanic process characteristic of the volcanites. With increasing depth the intensity of the metamorphic transformation increased considerably, giving a vertical zonal distribution of the described secondary minerals. The distribution of these minerals is characterized by a definite pattern associated with a change in the initial composition of the volcanites and the fluids entering into interaction with the volcanogenic rocks. Figures 4; references: 9 Russian.

5303/13046  
CSO: 1865/252

UDC 550.34

#### INCREASED-RESPONSE CHANNEL FOR REGIONAL SEISMIC STATION

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 24 Apr 84) pp 78-84

[Article by Yu.V. Shevchenko, B.I. Sennikov and Ye.S. Fedorov, Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences]

[Abstract] In the Kamchatka Regional Seismic Network the stations are outfitted with channels of the regional type with magnifications of 5,000-10,000. The records produced from such channels make possible reliable determinations of parameters of earthquakes in classes 8-9, but data are needed on weaker events. There is no way to upgrade the magnification level for the standard channel of a regional station due to the significant level of microseismic noise and certain technical factors. An electronic amplifier has been introduced for a channel of increased response, making possible a more flexible shaping of the amplitude-frequency characteristic channel. Circuitry was developed to meet this requirement (a circuit diagram accompanying the text is used in a detailed description of this circuitry). The necessary formulas are derived. The theory and method for calibration of the channel using a generator of harmonic signals are presented. The increased-response channel has been successfully tested. It is a practical supplement to the main channel in a regional station. However, it should be used only at stations with a low noise level, especially noise associated with vehicular traffic along roads. By using galvanometers with different frequencies of free oscillations and different damping, and also changing the transmission band of the filter and amplifier, it is possible to form different characteristics of the high-response channel. Figures 5; references: 2 Russian.

5303/13046  
CSO: 1865/239

SEISMIC ACTIVITY IN ZONE OF BAYKAL-AMUR RAILROAD LINE

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 1, Jan-Feb 86 (manuscript received 6 Jun 84) pp 93-98

[Article by V.M. Kochetkov and N.A. Gileva, Earth's Crust Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] Seismic conditions along certain stretches of the Baykal-Amur Railroad have been inadequately studied. The seismic regime criterion used is the  $A_{10}$  parameter determining the normalized density of earthquake epicenters and related to the mean parameters of their frequency of recurrence;  $A_{10}$  and the slope  $\gamma$  of the frequency of recurrence are the principal parameters describing the seismicity level. A composite  $A_{10}$  map was compiled for this zone using earthquake data regularly published in seismological bulletins of Siberia and the Far East. The considered territory, to the east of  $120^\circ E$ , is divided into three major seismically active regions (Stanovaya, Tukuringra-Dzhagdinskaya and Far Eastern). A table gives data on the earthquakes occurring within these regions during the period 1974-1980; data for the territory to the west ( $\lambda < 120^\circ$ ) are given as a comparison. Curves of the frequency of recurrence of earthquakes were constructed on the basis of the tabulated data. The  $\gamma$  values for the western and eastern regions were close ( $\gamma \approx 0.5$ ). For the Tukuringra-Dzhagdinskaya and Far Eastern regions the accuracy and the detail of the activity map were lower than in the western region (only earthquakes with  $K \geq 9$  were used and the error in determining epicenters averaged  $\pm 25$  km). The published map clarifies the relationship between the seismic field and geostructure. No detailed analysis is possible due to the low quality of the map for the eastern territory and the small scale of the map. The territory to the west of Olekma has high seismic activity; to the east of Olekma the relationship between the seismic field and geostructure becomes obscure. In the eastern part of the territory it is difficult to estimate the maximum possible magnitudes of earthquakes, but estimates are made for each sector. Figures 2; references: 7 Russian.

5303/13046  
CSO: 1865/239

UDC 553.981.2'982.2(571.5)

LENA-TUNGUSKA PROVINCE: PROMISING REGION FOR ORGANIZING NEW PETROLEUM AND GAS PRODUCTION BASE IN EASTERN USSR

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 86 (manuscript received 21 Jun 85) pp 3-14

[Article by A.E. Kontorovich, M.M. Mandelbaum, V.S. Surkov, A.A. Trofimuk and N.V. Cherskiy, Siberian Geology, Geophysics and Mineral Raw Materials Scientific Research Institute, USSR Ministry of Geology; Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk; Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences, Yakutsk; "Irkutskgeofizika" Geological Production Association]

[Abstract] All available geological and geophysical data were used in describing the geological structure of the Lena-Tunguska petroleum and gas province. This is an area with an enormous potential for petroleum and gas production (a map of petroleum and gas potential of the Siberian platform accompanies the text). The area is regionalized and the structure of the 11 defined regions is described. The area is characterized by Upper Proterozoic and Lower Paleozoic deposits. On the basis of comparative geology, the area was long underevaluated, since it was regarded as an unfavorable candidate for prospecting work, a point of view which was overcome after acceptance of the sedimentary-migration theory of napthoid formation, whose predictions proved to be entirely valid. The principal goals and tasks for the years 1986-1990 are outlined, followed by the desirable scenario for the exploitation of petroleum and gas reserves during the period up to the year 2000. Figures 1; references: 20 Russian.

5303/13046  
CSO: 1865/247

UDC 550.834

MULTIWAVE SEISMIC PROSPECTING IN SOLVING PROBLEMS IN PREDICTING GEOLOGICAL SECTION IN WESTERN SIBERIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 86 (manuscript received 3 Jun 85) pp 119-129

[Article by N.N. Puzyrev and G.V. Vedernikov, Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences; Siberian Geological Expedition, Novosibirsk]

[Abstract] Most geological prospecting work in Novosibirsk and Tyumen Oblasts is carried out using a combination of longitudinal transverse and exchange reflected waves and in Tomsk Oblast by a combination of longitudinal and exchange waves. In Tyumen Oblast work centers on the exploration of Neocomian deposits of hydrocarbons, but in Tomsk and Novosibirsk Oblasts it is Jurassic

deposits which are stressed. Since all detailed seismic prospecting work in Western Siberia is carried out by the reflected waves method, strong efforts were directed to developing a multiwave variant of this method. Among the transverse waves, preferences was given to waves with SH polarization. The processing and interpretation of these data are described in detail (including a comparison of the dynamic parameters of waves of different types). It is shown why in the future the role of dynamic analysis in multiwave seismic prospecting will increase. The use of multiwave seismic prospecting in solving problems in predicting the geological section has already reached the practical stage. Further progress requires a broadening of borehole observations at seismic and acoustic frequencies and improvement in techniques for processing and interpreting data using an electronic computer. There is need for development of high-resolution and three-dimensional modifications of multiwave seismic prospecting, further progress in the theory of heterogeneous media and introduction of new geoseismic models. The swampy and permafrost areas prevailing in Western Siberia also require modification of already devised methods and development of new observation and processing techniques. Figures 6; references: 10 Russian.

5303/13046  
CSO: 1865/247

UDC 550.348.098

#### GEOACOUSTIC PRECURSOR OF TRANSCARPATHIAN EARTHQUAKES OF 5 OCTOBER 1983

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 4, Apr 86  
(manuscript received 21 Jun 84) pp 79-82

[Article by T.Z. Verbitskiy and B.D. Boyko, Applied Problems of Mathematics and Mechanics Institute, USSR Academy of Sciences]

[Abstract] Anomalous changes in stresses and strains in an epicentral region are the best precursors of tectonic earthquakes. An automatic station for the continuous geoacoustic monitoring of the stressed-strained state of the crust was set up in the Carpathian Geodynamic Test Range in 1982. A source and receiver of waves of an acoustic frequency were installed in a mine drift at a depth of 28 m in the neutral temperature layer. Time series of geoacoustic parameters were obtained which revealed that the series consist of quasi-harmonic and aperiodic components. There was a close relationship between temporal variations of geoacoustic parameters and temporal changes in the tide-generating force, indicating a tidal nature of the quasi-harmonic component. In 1983 the strongest earthquakes in Transcarpathia ( $M \approx 3$ ) were on 4 and 5 October with epicenters about 35 km from the geoacoustic monitoring station. The station records revealed that almost 4 days prior to the event of 5 October the station registered anomalous changes in geoacoustic parameters which very probably are earthquake precursors. The general form of the precursor agrees well with the anticipated temporal variation of crustal deformations during the period of preparation for a tectonic earthquake. There is no unambiguous relationship between the amplitude of anomalies in the

temporal variations in the studied geoacoustic parameters and magnitude and epicentral distance of local tectonic earthquakes. Some events were accompanied by larger anomalies than closer earthquakes of about the same class and in other cases such anomalies were totally lacking. It is postulated that the different reaction of geoacoustic parameters to preparation of Transcarpathian earthquakes is determined by the block structure of the studied region and differences in the stress fields arising in preparation for different earthquakes. This remains unconfirmed. Figures 2; references 8: 7 Russian, 1 Western.

5303/13046  
CSO: 1865/343

UDC 550.3(571.64)+(265)

#### RESULTS OF GEOPHYSICAL STUDY OF SAKHALIN-KURILE ISLANDS-PACIFIC OCEAN PROFILE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian No 2, Mar-Apr 86 (manuscript received 6 Jan 84) pp 97-99

[Article by A.N. Petrov and I.S. Mazurova]

[Abstract] The article reports on an attempt to construct a topographic model of the earth's crust and core in the transition zone from continent to ocean using gravimetric data collected on the Sakhalin-Kurile Islands-Pacific Ocean profile during a cruise of the scientific research vessel "Pegasus" in 1984. Seismological and seismic measurements were also made and their findings made an inherent part of the model. Observed and calculated density values were reconciled by assuming varying density of the earth's upper mantle. Since S.A. Fedorov and I.P. Kuzin had noted in 1963 that anomalously low rates of longitudinal sound waves near the Kurile Islands could be followed to a depth of 100 km, and other studies had confirmed that finding, that thickness was used in the model, while in the Sea of Okhotsk a thickness of 150-180 km was used. Other anomalies suggest a mantle thickness of as much as 430 km. The calculated model differs from former ones in that the limits of the mantle are based on the R.Z. Tarakanov model of the Benioff zone, with a two-layer model of that zone showing reduced density and an underlying dense layer. Under the trench the mantle is reduced in density to a depth of 60 km, below which there is a layer with increased density down to 100 km. The shift in density between the regional seas and the Pacific Ocean is preserved to a depth of 100 km. References: 7 Russian.

12131/13046  
CSO: 1865/267

BIOGEOCHEMICAL EXPLORATION IN EASTERN UZBEKISTAN

Moscow RAZVEDKA I OKHRANA NEDR in Russian No 4, Apr 86 pp 26-30

[Article by V.F. Skryabin, OME, Central Asian Scientific Research Institute of Geology and Mineral Raw Materials]

[Abstract] Biogeochemical exploration in some 8,000 km<sup>2</sup> of mountains in Uzbekistan is hampered by the allochthonous deposits in the area. The article reports on study of 1,200 plant and 360 soil samples, including all genetic types and soil variations. Chemical analysis of soils determined minerals, humus, carbonates, gypsum and metabolized matter. Three basic types were identified: coarse eluvial-talus deposits up to 0.5-1 m in thickness, fine eluvial-talus deposits of 1-3 m in thickness and loamy loess soils up to 10 m in thickness, of indefinite origin. Uneven genetic strata and leached loam in lower soil layers were common. Soil composition, including content of copper, lead and zinc, is discussed; amounts of these minerals were found to increase with elevation. Carbonates were more common than water-soluble minerals. Sorption-saline metal ranges were also identified in the deep loess loam covering sulfide ores. Accumulation of metals in plants depended on physiological features of specific species, with proportional or barrier-free, barrier, increasingly resistant and extremely inverse plant types identified. The least blockage for metal absorption was found in origanum, wormwood, ferulae and astragalus, which should be raised experimentally in the area. Other results were generally inconclusive due to difficulties in interpreting bioanomalies in the study. Figures 2; references: 3 Russian.

12131/13046  
CSO: 1865/264

DESERTIFICATION - GLOBAL ECOLOGICAL PROBLEM

Moscow VOPROSY FILISOFII in Russian No 2, Feb 86 pp 113-123

[Article by N.S. Orlovskiy, Ashkhabad]

[Abstract] Among the problems of the 1970's, those of man-society-nature include environmental issues, and one of the most pressing and least studied at the social and philosophical level is that of desertification due to human causes. This process, which has affected 9.1 million square kilometers, has particularly harmed developing countries of Africa, Asia and Latin America in recent years, although its history extends back to prehistoric times. Causes include excessive cultivation and consequent degradation, unirrigated agricultural methods that take no account of specific ecological factors, irrational use of fossil fuel sources, destruction of plant cover by animals, roads and other construction, and mineral damage of various kinds rendering soils unfit for vegetation. Commonly, arid and semiarid regions have a

delicate balance that is easily disrupted and frequently irreversible. Urbanization and resultant destruction are a factor in the migration of formerly nomadic and agricultural populations to cities. Deserts have also typically been the sites of atomic test explosions with subsequent contamination and destruction of ground cover. Other aspects of the arms race ravage natural resources, including those found in arid regions, with ecological consequences of unknown magnitude. The author suggests that western practices and analyses of desertification fail to take social factors into account, and do not promote "progressive technology" that would preserve the environment while bringing progress. He claims that Soviet practices have minimized ecological damage by use of a different socioeconomic structure and by planning. In Central Asia, efforts since the 1930's have focused on controlling shifting sands with both dry grass and brush, as well as physicochemical means. In Turkmenistan sand dune damage to irrigated fields is, according to the author, completely controlled, although some local areas of desertification have been noted near well sites and in industrialized desert areas. Prevention of land damage in irrigated areas has required careful drainage system construction to avoid mineral deposits while making maximum use of ground water reserves. Technological backwardness is noted in some irrigated areas of Central Asia, and the extent of saline soils of various types is of concern. Disposal of irrigation water after its use is another problem still being resolved in Central Asia. Irrigation and water disposal in the basins of Syrdarya, Amudarya and Ili Rivers have caused a decline in the level of the Aral Sea. In addition, lands in the deltas of the Syrdarya and Amudarya have suffered desertification. Deposited salts have been blown onto irrigated lands, causing crop damage. Feed growth and sheep population have been reduced to help prevent further ecological harm. Forestation of 300,000 hectares with black haloxylon in the Zhanadarya watershed is dying because of reduced water flow. The author ends with a call for more rational land use everywhere and broader international cooperation. References 35: 29 Russian, 6 Western.

12131/13046  
CSO: 1865/261

UDC 550.343.6

#### METEOROLOGICAL PRECURSORS OF MAJOR EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 3, Mar 86  
(manuscript received 22 Apr 84) pp 36-47

[Article by M.R. Milkis, Geology Administration, Turkmen SSR; South Karakum Hydrological Expedition]

[Abstract] The article reports on study of correlation between meteorological phenomena and major earthquakes in Central Asia, particularly at Ashkhabad on 5 October 1948, Gazli on 8 April and 17 May 1976 and 20 March 1984, and others. Observations indicated that a long period of elevated temperatures preceded the earthquake at Kazandzhik for several years, as did increased temperatures at Ashkhabad in 1947-48 and at Tashkent in 1965-66. Similarly at Gazli,

steady temperature increases preceded the earthquakes of 1976 and 1984. These temperature increases, of 1.4 to 3°C, were accompanied consistently by reduced precipitation and lower humidity and other natural moisture phenomena. Reductions in atmospheric pressure and related increased winds were also observed. Abnormal numbers of clear days and resultant increased solar radiation complete the picture of meteorological phenomena that seem to precede major earthquakes. They appear to have value for predicting earthquakes. Figures 4; references: 7 Russian.

12131/13046  
CSO: 1865/260

UDC 550.34.038.4

LASER INTERFEROMETER FOR DEFORMOGRAPHIC OBSERVATIONS IN SURKHOB TECTONIC FAULT REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 3, Mar 86 (manuscript received 25 Apr 84) pp 80-87

[Article by V.A. Aleshin, A.S. Gorshkov, M.N. Dubrov, I.P. Ivanov and A.G. Skepko]

[Abstract] A laser interferometer with 1.25 m optical base and a photodiode to help control instability in laser intensity has been used since 1978 to measure mine ore deformations. It has a resolving power of  $10^{-9}$  relative units, but manifests various unstable features during operation. The article reports on study of approaches to stabilizing the interferometer laser in use as a geophysical instrument on the Surkhob River. The asymmetrical Michelson interferometer system is diagrammed and described. Long-term instability was determined to be  $3 \cdot 10^{-9}$  in 24 hours, while short-term instability was  $10^{-10} - 10^{-11}$  per minute depending on the interferometer design. Computer registration systems and computer connections with external instruments are described. Optical, frequency and registration errors limit the stability of the system, but it is still regarded as useful for studying microstructural variations due to its high response. Both slow and rapid processes can be studied, and the information is obtained in a form that can readily be analyzed. Figures 5; references: 5 Russian.

12131/13046  
CSO: 1865/260

ELECTROMAGNETIC RADIATION OF FRACTURE SURFACE DURING DESTRUCTION OF ION CRYSTALS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 1, Jan 86  
(manuscript received 14 May 85) pp 75-78

[Article by N.I. Gershenzon, D.O. Zilpimiani, P.V. Mandzhaladze, O.A. Pokhotelov and Z.T. Chelidze, Geophysics Institute, Georgian Academy of Sciences, Tbilisi; Earth Physics Institute imeni O.Yu. Shmidt, USSR Academy of Sciences, Moscow]

[Abstract] There are indications that seismic events are preceded by increases in electromagnetic radiation. The article reports on study of the effect of focusing a charge on the surface of a moving fracture during destruction of LiF crystals measuring 20 x 10 x 3 mm. In the absence of a fracture the laser beam did not strike the indentor surface. A high-ohm broad-band amplifier was used. Experimental data showed that the appearance of an electrical impulse is affected by the development of a fracture, while the shape of the signal is determined by the kinetics of its amplification. A negative charge is transmitted by the fracture surface as it moves. The linear charge amplitude was  $10^{-1}$  -  $10^{-2}$  units cgs/cm. Study of the charge transported by the fracture surface on 3 x 20 x (2-12) mm samples showed a linear dependence on fracture width, which is probably related to dislocational factors. Formulas were derived that help to explain the mechanisms of electromagnetic radiation during dielectric failure. References 13: 11 Russian, 2 Western.

12131/13046  
CSO: 1865/263

PHENOMENON OF HYDROCARBON GENERATION FROM HYPEROXIDIZED COMPOUNDS OF CARBON AND WATER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 288, No 1, Jan 86  
(manuscript received 11 Nov 85) pp 201-204

[Article by N.V. Cherskiy, academician, V.P. Melnikov and V.P. Tsarev, Mining of the North Institute, Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences]

[Abstract] Early study of oil and gas geology included attempts to determine the initial substances of their formation and the mechanisms by which they are transformed into hydrocarbons in upper layers of the earth's crust. Both transformation from organic compounds and synthesis from inorganic substances, including hyperoxidized carbonates,  $\text{CO}_2$  and other carbons, have been found. All forms but methane are known to decompose at temperatures above 500°C into

C, H<sub>2</sub> and CH<sub>4</sub> in the earth's mantle, thus indicating that hydrocarbon formation must take place in the crust. The theoretical bases of the geo-chemical process models are that under the effects of currents of mechanical forces, thermal energy and fluids, polarization occurs, leading to ion and particularly electron, charge transfer, which is of particular importance for hydrocarbon formation through electrochemical redox reactions. Such a reaction is  $\text{CO}_3^{2-} + 7\text{H}_2\text{O} + 8\text{e}^- \rightarrow \text{CH}_4 + 10\text{OH}^-$ . Theoretical and experimental confirmation is presented, indicating much broader prospects for finding oil and natural gas deposits. The second important significance of these findings is the likelihood of finding such deposits in crystalline and folded regions of the earth's mantle and in internal complexes lacking organic matter. Such hydrocarbon deposits can have formed at less than 250-300°C. References: 15 Russian.

12131/13046  
CSO: 1865/263

UDC 550.838

CALCULATION OF DERIVATIVE ΔT ANOMALIES USING MEASUREMENTS OF ALONG-COURSE GRADIENTS IN MODULUS OF EARTH'S MAGNETIC FIELD STRENGTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 86  
(manuscript received 23 May 84) pp 89-99

[Article by V.M. Gordin and V.O. Mikhaylov, Earth Physics Institute  
O.Yu. Shmidt, USSR Academy of Sciences]

[Abstract] The effectiveness of gradiometry to detect weak magnetic anomalies has been demonstrated but difficulties arise when interpreting the measurements of arbitrarily oriented anomalies. The possibility of transforming the variously oriented along-course measurements of the gradients to derivatives of the anomalous magnetic field along the coordinate axes was tested. A mathematical model of a gradiometric survey was formulated, the analytical apparatus is described and an analytical solution is given. Terms are derived and introduced into the model to simulate high-frequency random noise and systematic errors resulting from nonidentical detectors. A numerical experiment was set up, consisting of 13 predominately nonorthogonal, unevenly spaced traverses over an area containing 9 normally and reversely magnetized dipoles at a depth of 5 Δl in an area of 13 Δl x 13 Δl, where Δl is an arbitrary length, and containing 65 irregularly spaced measurements of the field gradient, giving a measurement density of  $0.38\Delta l^{-2}$ . It was shown that transformation of the unevenly distributed data to a square net produced no significant correlation of errors with the derived anomaly field. Addition of a constant systematic error, at 2% of the maximum signal difference, to the numerical experiment greatly distorted the derived anomalies, but the one-dimensional spline approximation algorithm used in the analysis removed the distortion and produced a derived and transformed anomaly field nearly identical to that before introduction of the systematic error. Figures 4; references: 13 Russian.

13144/13046  
CSO: 1865/251

RESULTS OF GEOMAGNETIC RESEARCH IN EPICENTRAL ZONE OF NAZARBEK EARTHQUAKE OF  
11 DECEMBER 1980

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript  
received 14 Jan 85) pp 288-291

[Article by Yu.P. Tsvetkov, K.N. Abdullabekov, Ye.M. Bezrodnyy, Ye. Berdaliyev  
and Kh.A. Tuychiyev, Institute of Terrestrial Magnetism, Ionosphere and Radio  
Wave Propagation, USSR Academy of Sciences; Seismology Institute, UzSSR Academy  
of Sciences]

[Abstract] The article reports on study of the aftereffects of the Nazarbek  
earthquake, with a magnitude  $M = 5.4$ , which occurred on 11 December 1980.  
Geomagnetic readings were taken in 1980-1982 at various stations. Early  
results showed a connection between changes in the local electromagnetic field  
in the epicenter and seismic variations. Geological and geophysical studies  
showed that there was a stepped uplift running from the west to the east,  
particularly between the Tashminvodsk and Karakamysh-Kelessk faults, where the  
basic submeridional faults are located. Geomagnetic studies showed a gradual  
reduction in geomagnetic force, which correlated with seismic changes; there  
were also more abrupt changes in the field. The Lenin-Yuly zone was considered  
to be in a compression region, while Nazarbek-2 was in the zone of dilatation.  
Within some 3 months after the earthquake, magnetic effects were largely  
normalized. Excess stress was released from rocks by the earthquake; this  
factor may be useful in predicting earthquakes and other geodynamic activity.  
Figures 3; references: 8 Russian.

12131/13046  
CSO: 1865/340

DEEP ELECTRICAL CONDUCTIVITY MODEL BASED ON GENERALIZED GLOBAL SOUNDING RESULTS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86 (manuscript  
received 18 Feb 85) pp 299-306

[Article by V.I. Dmitriyev, N.M. Rotanova, O.K. Zakharova and O.N. Balykina,  
Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR  
Academy of Sciences]

[Abstract] The basic goal of deep geoelectric research is the development of  
a dependable cross-section of the earth, and many studies have been done toward  
this end. This article reports on further studies of the reverse effect of  
global magnetic variation sounding (MVS) using new experimental materials.  
Contemporary geophysical data relating to the mineral composition of the  
earth's mantle are summarized, including possible growth of seismic waves,  
density, and mean electrical conductivity. Mineral zones of the mantle

include the olivine upper zone (70-420 km), the transitional zone, a zone of spinel, perovskite and ilmenite at 670-1,000 km and the lower mantle (1,000-2,800 km), mainly of perovskite. The effects of temperature and pressure in turning olivine into semiconductors is also considered; its importance decreases with increasing depth. These and other data are used to construct a mathematical model for a constant analog using splines and polynomial regressions. The resolution of optimum model parameters and their changes as a result of the influence of the earth's oceans contributed to the construction of a mathematical model for deep electrical conductivity. It is not complex and accurately describes physical processes taking place in the depths of the planet. Figures 2; references 13: 9 Russian, 4 Western.

12131/13046  
CSO: 1865/340

UDC 551.521.3:551.510.42:551.508.9

OPTICAL-MICROSTRUCTURAL CHARACTERISTICS OF SOIL AEROSOLS

Moscow IZVESTIYA AKADEMII NAUK: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 2, Feb 86 (manuscript received 10 Feb 84, after revision 27 Jul 84) pp 169-176

[Article by L.P. Dinmukhametova, I.A. Mogilyuk and Yu.G. Toporkov]

[Abstract] The absorbing properties of soil aerosols were studied in the visible and near-IR spectral regions where soil aerosols play an important role in the attenuation and absorption of radiation in the atmospheric surface layer. A study was made of the optical properties of 20 samples of soil origin, using a spectrophone for this purpose. The relative spectra of particle sizes were determined from microphotographs taken with an electron microscope. For example, it was found that the probabilities of light quantum absorption  $\chi/\alpha$  at  $0.44 \mu\text{m}$  have characteristic values 0.03, 0.045-0.06 and 0.08, whereas at  $1.06 \mu\text{m}$  these values drop by a factor of 10-20 (0.003-0.004 and 0.005-0.006). Bimodal log-normal distributions with  $r_g \approx 0.0015 \mu\text{m}$  and  $r_g \sim 0.1 \mu\text{m}$  can be used in describing the relative spectra of particle sizes in the range  $0.001-5 \mu\text{m}$ . Definite values were obtained for the imaginary parts of the complex refractive index. Figures 4; references 11: 10 Russian, 1 Western.

5303/13046  
CSO: 1865/305

UDC 534.231.1

EVALUATING NONLINEAR EFFECTS IN PROPAGATION OF ACOUSTIC PULSE IN ATMOSPHERIC SURFACE LAYER IN INVERSIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 2, Feb 86 (manuscript received 13 Jun 84) pp 151-159

[Article by I.P. Chunchuzov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] The general features of propagation of powerful acoustic disturbances in the atmospheric surface layer were analyzed. They can be generated

by natural sources, such as volcanic eruptions, earthquakes and thunderstorms or by such artificial sources as powerful explosions. An attempt was made to clarify the contribution made by nonlinear effects to the process of propagation of powerful acoustic disturbances in a surface waveguide. It is shown that in some cases such a nonlinear process of waveguide propagation of sound can be described by a nonlinear equation which is a nonlinear analogue of the well-known parabolic equation. Proceeding on this basis, it is shown that in the case of a point source nonlinear effects and waveguide dispersion can result in the appearance of cylindrical solitons at great distances which attenuate with distance far more slowly than a linearly propagated pulse. An equation is derived whose solution describes slow change of the initially plane soliton in the course of propagation. The amplitude of such a soliton decreases as  $r^{-2/3}$ , whereas the width increases as  $r^{1/3}$ . Figures 1; references 12: 11 Russian, 1 Western.

5303/13046  
CSO: 1865/305

UDC 551.511:551.576

#### EXPERIMENTAL RESEARCH ON TURBULENCE IN UPPER-LEVEL TROPOSPHERIC CLOUDS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 22, No 2, Feb 86 (manuscript received 21 Jun 84) pp 143-150

[Article by V.K. Dmitriyev, T.P. Kapitanova, V.D. Litvinova, N.Z. Pinus,  
G.A. Potertikova and G.N. Shur, Central Aerological Observatory]

[Abstract] Flight studies of turbulence in cirrus clouds were made in late 1981 and early 1982 by Central Aerological Observatory specialists. The experiments were carried out in a number of regions using an IL-18D aircraft laboratory with a wide array of scientific instrumentation for measuring mean temperature, humidity, wind velocity and direction, fluctuations of temperature and the horizontal and vertical components of the wind vector. Parameters were measured in two ranges of spatial scales of disturbance (from hundreds of meters to 2-3 km and from 5-6 to 30-40 km). The two ranges correspond to micro- and mesoscale pulsations. Horizontal flights with a length up to 500 km were made at 5-6 levels. Nineteen multilevel flight experiments were made. Flights were made in cirrostratus clouds and in the clear sky (few flights were made in Ci). The collected data were used in constructing vertical atmospheric sections and in tabulating the results of synchronous measurements of the vertical and horizontal fluctuations of velocity and temperature fluctuations, rate of dissipation of turbulent energy into heat, rate of evening-out of temperature inhomogeneities and structural characteristic of the fluctuating temperature field. This made it possible to define the distinguishing characteristics of turbulence in cirrostratus clouds and in jet streams. Figures 5; references 8: 7 Russian, 1 Western.

5303/13046  
CSO: 1865/305

## SOLAR CONTROL OF GEOPHYSICAL PHENOMENA

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 86 pp 58-61

[Article by V.F. Loginov, doctor of geographical sciences, and G.V. Fedorovich, doctor of physical and mathematical sciences]

[Abstract] An all-union conference on "Interrelationship of Meteorological Phenomena and Processes in Circumterrestrial Space" was held in Moscow in January 1985 and was attended by meteorologists, seismologists and specialists in the physics of the upper atmosphere. The purpose was a review of progress in study of different mechanisms of interrelationships of geophysical and meteorological processes and phenomena in the upper atmosphere and in space. Ye.P. Borisenkov, et al., have studied the change in the influx of solar radiation to the earth during the last century. On the basis of data on parameters of the earth's orbit and brightness of the solar disk they concluded that the influx of solar radiation is decreasing not only due to a change in the brightness of the solar disk, but also due to a change in the parameters of the earth's orbit with a duration from several years to several decades. There were solar activity maxima in the 1930's and early 1940's, as well as in the early 1890's (approximately 40-45 years apart). During the latter periods a relatively high air temperature prevailed in the northern hemisphere, but in the 1890's the solar activity effect was obscured by a burst of volcanic activity. A.D. Danilov discussed changes in composition and temperature of the ozone layer under the influence of UV radiation and cosmic rays. Although ozone for the most part is found in the lower and middle stratosphere and solar flares have little effect on its total content, there is good basis for assuming that the ozone mechanism plays a definite role in changes in weather and climate. V.A. Troitskiy dealt with the role of the earth's electrical field in solar-terrestrial relationships, which plays an important role in the propagation of disturbances in the circumterrestrial medium and must be taken into account in studying the process of preparation of earthquakes. Prior to an earthquake small fractures appear in the earth's crust and electrical charges of opposite signs appear on their edges and an electrical field forms in the fracture and around it with the result that over great areas the total field can attain hundreds and thousands of volts per meter. As a result, several hours before a seismic event conditions may develop somewhat similar to those preceding a thunderstorm. When such a strong electrical field penetrates into the ionosphere there can be catastrophic results. The electron concentration in the ionosphere changes, strong turbulent flows develop and plasma temperature and pressure increase, resulting in large-scale convective flows. The conferees resolved that increased attention must be given to the modeling of possible mechanisms of the influence of helio-geophysical factors on the lower atmosphere and lithosphere and then experimental checking of the postulated mechanisms. Work must continue on developing ways to use heliophysical information in the preparation of long-range and superlong-range meteorological and seismic forecasts. Figures 2.

5303/13046  
CSO: 1865/308

EFFECT OF PULSATING AURORAS ON FREQUENCY-TIME CHARACTERISTICS OF RADIO SIGNALS REFLECTED FROM AURORAL IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 16 Apr 85) pp 243-246

[Article by A.A. Arykov, I.N. Bardeyev, A.N. Vasilyev, V.G. Korotkov, A.M. Royzen and S.A. Rumyantsev, Polar Geophysical Institute, Kola Affiliate, USSR Academy of Sciences]

[Abstract] The spectrum of constant wave radio signals reflected and dissipated by the ionosphere can provide much information about processes in the ionosphere. The article reports on experimental study of dynamics of spectral variations of radio signals reflected from the auroral ionosphere during periods of pulsating auroras. The experiments were conducted on a 60 km path at a geomagnetic latitude averaging 63°. A constant signal with plane polarization was sent at 3.3 MHz. Analysis of experimental data show that the undisturbed signal, in a band of several Hz around the working frequency, was expanded noticeably in amplitude by the aurora disturbances. Optical pulsations and spectral variations support the explanation of spectral variations as a result of Doppler frequency shifts and changes in electron concentration profiles. Auroras with an interval of about 10 seconds were accompanied by specific variations in SW radio signals reflected in the E region of the auroral ionosphere. Spectral variations are explained by the Doppler shift of signal frequency during changes in ionization density created by rapidly changing currents of precipitating electrons during pulsating auroras. Figures 3; references 10: 7 Russian, 3 Western.

12131/13046  
CSO; 1865/340

PHASE FLUCTUATIONS OF IONOSPHERE RADIO SIGNALS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 1 Mar 86) pp 247-252

[Article by V.D. Gusev and M.B. Vinogradova, Moscow State University]

[Abstract] Phase fluctuations have been observed in reflections of radio signals in regions of the ionosphere containing various inhomogeneities. While these fluctuations affect operations of radio systems, they also offer new information about the structure and dimensions of scattering inhomogeneities. The article attempts to use geometric optics for correct expression of wave phase reflections from the ionosphere during oblique propagation. Calculations take account of dielectric permeability and beam trajectories. A second series of calculations related to determination of phase fluctuations

of waves during propagation in a fixed-thickness layer with slant incidence relative to the boundary. Fluctuations of horizontal beam shift at the output from the distributive layer are also treated mathematically. Results indicate that ionospheric inhomogeneities can be used to determine dielectric properties of materials. References: 2 Russian.

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CSO: 1865/340

UDC 550.388.2

#### TRANSVERSE RESONANCES OF EARTH-IONOSPHERE WAVE GUIDE IN AURORAL REGION

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 13 Mar 85) pp 253-257

[Article by V.S. Smirnov and A.A. Ostapenko, Polar Geophysical Institute, Kola Affiliate, USSR Academy of Sciences]

[Abstract] Contemporary studies of low-frequency radiation have defined the precise structure of such signals in the auroral region. This article reports on study of spectral and polarized features of transverse resonances and the relationship to ionospheric parameters. So-called Schumann resonances have been studied with frequencies from a few to tens of Hz. Strong attenuation in that range virtually excludes wave interference and makes it difficult to generate global resonances in the kilohertz frequency range. Thus, modulations in those frequencies are local in nature. They make it possible to use a plane model of the earth-ionosphere wave guide and allow direct determination of the wave equation, which is discussed. Results show that at high latitudes degeneration effects are manifested in periods of leakage of hard particles when the ionosphere is at low altitudes; soft particles are found when the ionosphere limits are at higher altitudes. A stepped mathematical model gave a rough approximation of actual ionization. Ordinary and extraordinary modes were found to correspond to waves of left and right polarization, respectively, with relatively low values for particle disintegration. Theoretical values correlated well with experimental data on low-frequency radiation waves. Figures 2; references 9: 8 Russian, 1 western.

12131/13046  
CSO: 1865/340

REGULAR NOISE BACKGROUND IN VLF-RADIATION AND WORLD THUNDERSTORM CENTERS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 16 Apr 85) pp 258-264

[Article by G.I. Druzhin, T.V. Toropchinova and V.I. Shapayev, Institute of Space Research and Aeronomy, Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences]

[Abstract] Regular noise emissions (RNE) in VLF radiations are typified by their constant nature. This article reports on attempts to develop qualitative analysis procedures for defining various sources in the RNE amplitude by observing the day-long course of intensity at several recording stations. Signal azimuth findings were made using a magnetic dipole antenna. A preliminary hypothesis held that only two sources, discrete and isotropic points, contributed to RNE amplitude. Actually, it was found that two or more sources could be involved simultaneously. Error for three factors are discussed: the RNE source with extreme limits, several simultaneous discrete sources and measurement error parameters. Varying evening and nighttime readings were recorded, with minor morning changes as well. They were found at all recording stations. Quasi-constant azimuths of radiation during definite periods indicate that localized RNE sources should exist during these periods. During fall and winter periods, world thunderstorm cells were found to play a key role in RNE formation, but further research is needed to determine whether thunderstorm activity alone accounts for RNE generation. Figures 3; references: 10 Russian.

12131/13046  
CSO: 1865/340

SPATIAL RADIO WAVE ATTENUATION DURING VERTICAL SOUNDING OF IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 1 Jul 85) pp 322-325

[Article by P.F. Denisenko, V.I. Vodolazkin and G.G. Vertogradov, Rostov-on-Don State University]

[Abstract] The article reports on study of radio wave attenuation due to energy losses in the ionosphere. The field is expressed by the equation:  $E = A \exp(-L_e / r_{eff})$ . It concentrates on determining the effective distance in the actual ionosphere in relation to an illuminated area of the earth's surface. The vector of the inverse geomagnetic field strength effect is also included in the mathematical model. The authors note that the results are reliable for all but the longitudinal propagation of regular radio waves. Corrections are suggested. The method has a correctable level of error. Figures 1; references 5: 1 Russian, 4 Western.

12131/13046  
CSO: 1865/340

EFFECTS OCCURRING DURING ELECTROMAGNETIC FIELD RECEPTION NEAR POWERFUL HEAT CURRENT

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 26, No 2, Mar-Apr 86  
(manuscript received 12 Feb 85) pp 359-361

[Article by V.N. Kunin, M.S. Aleksandrov, N.G. Konopasov, B.A. Khadzhi, A.A. Kuznetsov, L.V. Semenova, T.V. Shepilova and V.P. Tereshchenkov, Vladimir Polytechnical Institute]

[Abstract] Numerous studies have been made of nonlinear effects in electromagnetic fields resulting from artificial effects induced in the ionosphere by powerful radio emissions. The article reports on such phenomena under the influence of strong heat currents which create additive or multiplicative variations in the earth's magnetic field. A large dipole emission device with 9 Hz power and a variable heat current source which were used are diagrammed and discussed. Regular and modulating heat currents were created. Results indicated that reducing the amplitude during modulating operation created more of an additive magnetic field supplement, perhaps explained by the multiplicative effect related to conditions near the measuring device and the receiver. Thus, both additive and multiplicative effects were registered in the signal being received as a result of the heat current. Figures 2; references: 4 Russian.

12131/13046  
CSO: 1865/340

RADIATION DENSITY AND ABSORPTION IN VERTICALLY INHOMOGENEOUS ATMOSPHERE WITH UNDERLYING SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 22, No 4, Apr 86 (manuscript received 11 Nov 84) pp 349-357

[Article by L.M. Romanova, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] The method for solving the transfer equation in a homogeneous medium proposed by V.S. Boffi, et al., (J. QUANT. SPECTROSC. RADIAT. TRANSFER, Vol 18, No 2, pp 189-203, 1977) was generalized for determining radiation density in a vertically inhomogeneous atmosphere illuminated by the sun. The atmospheric (oceanic) model used is a plane layer of turbid medium with the thickness  $z_0$ , with the origin of coordinates at the upper boundary of the layer. The volume scattering and absorption coefficients are functions of the vertical coordinate  $\sigma(z)$  and  $\alpha(z)$ . The absorbing substance can be an aerosol, including cloud droplets and crystals or gas. The method for describing vertically inhomogeneous gas absorption by means of absorption

coefficients was given earlier by L.M. Romanova, et al., IZV. AN SSSR, FAO, Vol 18, No 3, pp 240-250, 1982. The radiative influx is determined from the density of radiant energy. The latter is computed in the transport approximation by the integral transforms method for optically homogeneous turbid media. A rather simple formula was derived for the case of a linear dependence of the probability of survival of a quantum on optical depth, corresponding to the transport approximation. This formula makes it possible to evaluate the influence of the value and sign of the  $\Lambda$  gradient on the radiative influx to the entire atmospheric layer. References 22: 18 Russian, 4 Western.

5303/13046

CSO: 1865/338

ARCTIC AND ANTARCTIC RESEARCH

'SP-28' ARCTIC STATION IN OPERATION

Moscow SOVETSKAYA ROSSIYA in Russian 22 May 86 p 4

[Text] Leningrad, 21 May (TASS)--The call letters of the new Soviet drifting station "Severnyy polyyus-28" (SP-28) have been heard on the air. The first weather summary, which has been transmitted to the mainland from the 80th parallel in the Central Polar Basin, is traditionally considered the 'calling card' of a new floating center of polar science--official notification that it has begun its work.

A Young Communist group has taken on the first shift of the scientific duty at "SP-28." This group is to master a new generation of research equipment for the study of the Arctic. A portable computer complex with an automated system for gathering and processing information and transmitting it via satellite communications channels will operate for the first time at the station. This will make it possible to expand the volume of observations of the atmosphere, ice and ocean, and to supply synoptic data quickly to on-shore weather-service centers and headquarters of shipping operations along the Northern Sea Route.

FTD/SNAP  
/13046  
CSO: 1865/280

## SHIPS RETURN FROM ANTARCTICA

Moscow DOMESTIC SERVICE in Russian 2100 gmt 22 May 86

[Excerpt] Seven ships of the 31st Soviet Antarctic Expedition have completed the tasks entrusted them and have left the high southern latitudes. The science vessels "Professor Vize" and "Professor Zubov," the dry-cargo vessel "Pionyer Estonii" and the liner "Baykal" have already returned to their home shores. The diesel electric motor vessels "Kapitan Gotskiy" and "Kapitan Bondarenko" are heading for ports in the Baltic and in the Far East. As our correspondent was told at the Ministry of the Maritime Fleet, the scientific expedition vessel "Mikhail Somov" has also set out on a course for Leningrad. The Baltic seamen have carried out their last transport operation in the seas of the southern ocean. It took place near Bellinsgauzen station on Waterloo Island situated near Drake Sound.

/13046  
CSO: 1865/281-E

IL-18D AIRPLANE OUTFITTED FOR RESEARCH IN ANTARCTICA

Moscow IZVESTIYA in Russian 23 Jul 86 p 1

[Article by V. Belikov]

[Excerpt] Next autumn the arsenal of technical equipment used by our scientists on the Antarctic continent will include a complete flying laboratory, the IL-18D turboprop "Antarktida."

Last November, at a man-made snow-and-ice airfield at the foot of the [Antarctic] mountain Vechernyaya, the airliner with bright-colored wings had its passenger cabin refurnished. In place of several rows of seats, there appeared makeshift tables with instruments and work stations for operators.

The equipment which was tested then made it possible not only to 'inspect' from up high all details of the relief of the gigantic ice dome, but also as if to peer beneath this permanently frozen armor.

I. Abdullin, commander of a division of the Domodedovo Aviation Enterprise, related after he had returned home: "We spent 50 hours in the skies over Antarctica. Our navigation charts became lined with routes through the previously unmarked patch of white surrounding the South Pole. Experimental aerial photographs demonstrated the undeniable advantages of the heavy four-turbine laboratory-airplane in comparison with the IL-14, which is not as big, and the very small AN-2 biplane."

The IL-18D no longer will be used for transporting teams of polar expeditions. Upon its return from the Southern Hemisphere, it went to an aircraft plant where its flight-service specialty was changed for good; it retained, though, its capability to fly more than 5,000 kilometers without landing. The interior of its fuselage has lost any similarity with an Aeroflot liner.

I was told that in the future, this cabin will be the workplace of personnel of a flying laboratory on flights lasting many hours over land and ocean. Its instrumentation would be the envy of any institute. More than 40 sets of various instruments line both sides of the cabin. There is a radar that is able to see under the ice and to 'draw' the relief on a screen.

Pilots and operators of the "Antarktida" airplane have just completed a series of trial flights in the polar region [of the North].

FTD/SNAP

/13046

CSO: 1865/358

RESEARCH SHIP 'PROFESSOR ZUBOV' RETURNS FROM ANTARCTICA

Leningrad LENINGRADSKAYA PRAVDA in Russian 21 May 86 p 2

[Article by T. Volgina]

[Abstract] The research ship "Professor Zubov" returned yesterday to Leningrad after completing its 40th cruise.

As part of the flotilla of the 31st Soviet Antarctic Expedition, it brought a new contingent of polar scientists to the sixth continent and took on board the winter contingents who had completed their difficult tour of duty at the Leningradskaya, Russkaya and Molodezhnaya stations.

Together with another ship of science, the "Professor Vize," multiple studies under the program "Polar Experiment South-86" were successfully completed. In the Pacific Ocean sector and in the Ross Sea and adjacent waters of the southern oceans, hydrologists conducted oceanologic and meterologic measurements for studying the circulation of water masses.

The data and results of the detailed oceanologic survey were immediately processed by the "Professor Vize" shipboard computer.

FTD/SNAP  
/13046  
CSO: 1865/280

IL-76md AIRPLANES DROP CARGO AND PERSONNEL AT ARCTIC STATION

Moscow KRASNAYA ZVEZDA in Russian 24 May 86 p 4

[Article by S. Nechayuk, correspondent on board an IL-76md airplane from Tiksi]

[Abstract] The article reports on an airlift of personnel and cargo from the mainland town to Tiksi to the ice floe of the Arctic drifting station SP-28. The operation was called EKSPARK-86. [See the Daily SNAP, 9 May 86 p 4.] Two IL-76md airplanes flew from Tiksi on 23 May with 18 parachutists. Reaching the area of the drop, they descended to 600 meters, just below the cloud cover. Each airplane first dropped a platform loaded with fuel drums, and then dropped other cargo items. The parachutists then jumped, and all were said to have landed safely on the mark.

Remarks of Yuriy Andreyevich Koba, head of the aviation group of EKSPARK-86, and of other members of the parachutist group and of the airplane crew are recorded.

FTD/SNAP  
/13046  
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## NEW SEARCH-AND-RESCUE EQUIPMENT TESTED IN ARCTIC EXERCISE

Moscow TRUD in Russian 30 May 86 p 4

[Article by V. Gusarov]

**[Abstract]** The article reports on a recent training exercise for search-and-rescue services in the Arctic.

The effectiveness of the newest search-and-rescue equipment in extreme conditions was tested in this experiment. Seven parachutists of the All-Union Volunteer Society for Assistance to the Army, Air Force and Navy played the role of accident victims stranded on an ice floe. In a conversation, Aleksandr Zakharovich Sidorenko, who headed this group, noted that such accidents could occur during airlift operations for supplying Arctic drifting stations.

The exercise began one morning when Sidorenko's group left Tiksi on board an AN-12 airplane. A suitable ice floe was spotted at a point in the Laptev Sea about 250 kilometers from Tiksi. The group parachuted to the floe and inflated an emergency raft with a tent top which is bright yellow and red. A number of emergency transmitters were turned on, including buoys of the "Kospas-Sarsat" system and one of the latest radio sets, a supercompact unit called "Avariya-2." It was switched on at 5:55 a.m. Nine minutes later, its signal was picked up by a satellite. At 6:35 a.m., the Vladivostok receiving center of "Kospas-Sarsat" determined the location of the group from the signal from the satellite. An AN-12 airplane carrying two airdrop rescue groups left Tiksi within an hour. The groups parachuted to the ice floe 10 minutes after the airplane's commander spotted the bright-colored tent, reportedly from a distance of 50 kilometers. An MI-8 helicopter equipped with reserve fuel tanks then flew to the ice floe and evacuated its occupants. The entire operation took only 5 hours.

Sidorenko said that the experiment demonstrated that help can be rushed very quickly to any point in the Arctic. Yu. Atserov, chairman of the All-Union Marine Satellite Communications (Morsvyaz' sputnik) Association, praised the performance of the "Kospas-Sarsat" system in the difficult conditions of the Arctic.

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## PROPOSALS FOR ADVANCEMENT OF YEAR-ROUND ARCTIC SHIPPING

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[Article by L. Timokhov, doctor of physical-mathematic sciences, secretary of the Communist Party committee of the Arctic and Antarctic Scientific Research Institute, and N. Mustafin, head of a department of the institute, USSR State Prize laureate]

[Abstract] The authors discuss tasks for improving the planning and coordination of technological progress in all modes of transportation in the Arctic region. They complain of inaction on proposals which were made by the Arctic and Antarctic Institute (AANII) in 1983. The institute recommended, in particular, the drafting of a large-scale, targeted interagency program for creative cooperation among organizations in support of year-round shipping in the Arctic.

Reiterating the need for such a program, the authors point out that existing programs in this field are narrow in scope, and that there has been insufficient coordination of the work being done by the concerned ministries, or even by organizations affiliated with the same ministry or agency. One consequence of this has been that the growth of the transport icebreaker fleet is outstripping the development of equipment for its hydrometeorological support. The authors say that the feasibility of developing water, air, rail and motor transport in the Arctic and Far North requires more thorough substantiation from the economic and social standpoint.

Pointing out that AANII's proposals have received support from 20 major organizations, the authors call these proposals to the attention of a number of ministers, including T.B. Guzhenko of the Ministry of the Merchant Fleet, B.P. Bugayev of the Ministry of Civil Aviation, A.S. Systsov of the Ministry of the Aviation Industry, and I.S. Belousov of the Ministry of the Shipbuilding Industry. The authors call also for creating an automated interindustry information system for the Arctic region, as the first stage of development of a management information system for sea and river operations in this region. They recommend that an intersector scientific-technical complex called "Artika" be created for the purpose of coordinating work on such important problems as mastering year-round shipping over the entire Northern Sea Route, and exploiting mineral resources of the coastal-shelf zones of Arctic seas.

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COAL GAS MIGRATION IN PERMAFROST REGIONS

Moscow SOVETSKAYA GEOLOGIYA In Russian No 5, May 86 pp 30-32

[Article by V.V. Shershukov and V.N. Khudyakov, Moscow Geological Prospecting Institute]

[Abstract] Numerous coal basins are located in the permafrost areas of the USSR and their safe exploitation requires that the presence of explosive gases be taken into account. An extensive literature now exists on the influence of permafrost on the migration of such gases in coal basins, but there has been contradictory information on the permeability or impermeability of permafrost for such gases. It now seems established that such migration is possible, but the nature of the process has remained unclear, although it seems that the lower boundary of the permafrost layer is most impermeable. On the basis of accumulated data, it was possible to postulate the mechanism for penetration of gases into the permafrost layer through the usually impermeable lower boundary. A fracture below the boundary constitutes a potential channel into the frozen layer, but it is usually filled with ice. At the time of neotectonic movements some of the gas penetrates along the temporarily open channel into the permafrost layer, resulting in accumulation in the most favorable zone. Neotectonic movements and the entry of gas into the permafrost layer occur in bursts, the gas entering in definite portions at the time of each neotectonic burst. Each new burst raises the gas pressure in the permafrost layer. In the absence of neotectonic movements, the lower boundary is virtually impermeable. This clarification of the mechanism of formation of micropools of explosive gases will make possible a more correct prediction of their possible size and temporal dynamics, revealing the nature and scale of gas release into underground mine workings when exploiting coal deposits. Figures 1; references: 8 Russian.

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HISTORY OF RELIEF DEVELOPMENT ON SHELF IN EASTERN SOVIET ARCTIC

Moscow SOVETSKAYA GEOLOGIYA in Russian No 5, May 86 pp 72-84

[Article by A.P. Puminov, All-Union Scientific Research Institute of Oceanology]

[Abstract] All available information has been brought together to describe the principal features in the history of development of relief and structure of the Cenozoic cover of the present-day coastal shelf and Cenozoic paleoshelf and to clarify the main stage in relief formation, which exerted a decisive influence on morphostructure of the shelf region and its role in placer formation. An effort was made to delineate groups of regions characterized by similarities of present-day and buried relief and similar structure of the Cenozoic cover and patterns of distribution of terrigenous metal-bearing formations. Integration of all data made it possible to compile a two-page table giving a comparison of the main events in the development of relief and sedimentation in the Eastern Arctic shelf region. Individual areas are examined in detail. A paleogeographic zonality is defined which gives a very important idea concerning the location of areas with exogenous factors favorable for the formation of placer deposits. It can be used in defining potential zones of shelf placer formation and, therefore, in possible prediction of areas which may have metal-bearing placers. Two stages in the Cenozoic were established which differ with respect to tectonic movements, climate, nature of regressions and transgressions, incision of rivers and filling of valleys. This constitutes a further basis for the delineation of morphogenetic regions, a basis for determining the patterns of distribution of placer deposits. Figures 4; references: 8 Russian.

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